DIABETES
&
The Diabetic in the Community

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FOREWORD

DIABETIC nursing is receiving new and desirable emphasis in the nursing curriculum Mary Tangney's book, the first of its kind, answers an essential need

The rôle of the nurse in today's diabetic clinic is a major one including the teaching of patients in office or hospital groups, the care of the complicated foot case, the care of the obstetrical and the surgical patient, the emergency coma or hypoglycemic patient and supervision of children's diabetic camps Miss Tangney has served in nearly all these capacities at the George F Baker Clinic and at the Hartford Hospital

Like Dr R D Lawrence, Miss Tangney has an intimate knowledge of the emotional and psychological problems of the diabetic

For all these reasons her excellent book will give immeasurable help to the student and the graduate nurse

PRISCILLA WHITE

PREFACE

The content of this text is based on the objectives as outlined in the section on diabetes in the Public Health Nursing Curriculum Guide of 1942 as prepared by a joint committee of The National Organization for Public Health Nursing and The United States Public Health Service

Dr Elliott P Joslin has said that the further improvement in care of diabetic patients lies not in the hospital, but in the home With this thought in mind, the writer has tried to stress the *teaching of the diabetic person* who lives in the community rather than the *nursing of the diabetic patient* who is in the hospital

In teaching, the most effective results come from systematized group-instruction which is further individualized by conferences, but many diabetic persons live in small towns and rural areas which are far removed from the established clinics where such group instruction is feasible Yet, they too require a practical education which will not only enable them to avoid the degenerative complications of poorly controlled diabetes, but which will enable them to take their part in the activity of the community in which they live With such a consideration in mind, this text emphasizes the instruction of individuals with diabetes whom the nurse meets daily in their homes, in the schoolroom, in business, and in industry

Without assistance from many persons, this manuscript could not have been assembled The writer is

particularly grateful to Dr Elliott P Joslin for the valuable years spent in teaching diabetic persons under his supervision To Dr Priscilla White for her inestimable contribution of philosophy and insight into the orientation problems of the diabetic person to his disease, and for most of the information contained in the chapters concerning diabetes in childhood and in pregnancy To Miss Ethel A Brooks, Director of the School of Nursing and Nursing Service at Hartford Hospital, for her encouragement, interest, and understanding of the problems involved in the establishment of a diabetic patient teaching program To Miss Margery F Marshall, faculty member of the Brighton High School, Brighton, Massachusetts, for her corrective reading of the entire manuscript To many of the faculty members of Hartford Hospital School of Nursing in particular Miss Rose K Bernhard, Miss Doretta Thielker, and Miss Florence C Kempf, for their invaluable readings and suggestions concerning the manuscript content To the physicians on the staff of Hartford Hospital, particularly Dr Burdette J Buck, Dr Ralph E Kendall, Dr Robert Tennant, and Dr John T Leonard, for their advice and counseling To the W B Saunders Company for editorial assistance and helpful criticism

MARY E TANGNEY

Hartford, Connecticut
August, 1947

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DIABETES IN THE NATIONAL PICTURE

Diabetes mellitus ranks seventh as a cause of death in the United States today It has been estimated that 25 per cent of the populace actually carries the diabetic trait, and that although the percentage of carriers remains essentially the same, the number of persons developing the disease is constantly increasing and will continue to increase at an even greater rate than will the population

FACTORS INFLUENCING INCREASED MORBIDITY

INCREASED LONGEVITY OF THE POPULATION

Although no age period is exempted from the development of diabetes, the disease is essentially one of later life, for only one fourth of all diabetics in the United States are under fifty years of age whereas one half of all diabetics are sixty years of age or older [1] This latter figure is striking because only one ninth of the entire population is sixty years of age or over

That the population is living longer is evinced by the fact that in 1900 the average age at death was 35 2 years, in 1937, 54 4 years, and in 1945, 64 8 years This increased life span has had a direct effect on the increased

[1] Spiegelman, M, and Marks H H Age and sex variations in prevalence and onset of diabetes mellitus (1940 data). American Journal of Public Health January, 1946

incidence of diabetes because the longer the life span, the more possible it is for those individuals who are hereditarily predisposed to diabetes to develop the disease

This view is further substantiated by the fact that in states where an older age group predominates the incidence of diabetes is high An industrialized state like Massachusetts, for example, has diabetics at the rate of thirty three per 100,000, Arizona, by way of contrast, has an appreciably younger average age and the lowest incidence of diabetes in all forty eight states In Arizona, the mortality rate for diabetes was ten per 100,000 in 1937, in Rhode Island, it was forty-two However, when standardized adjustments were made for consideration of Arizona's younger age of population, ratio of males *to females, number of Jews, medical facilities, and death* certificates available for statistical purposes, the morbidity rates for Arizona and Rhode Island were more nearly parallel [2]

LONGEVITY OF FEMALES

Statistics show that women, in general, live longer than men, thus, as the life span lengthens, the greater will be the preponderance of females in the population It is not surprising, then, to find that 61 5 per cent of all diabetics are females and 38 5 per cent are males [1] Diabetes, in its broadest conception, is considered to be a multiglandular endocrine disease, and the markedly high incidence in females after the age of forty years is thought to be influenced by physical changes which are coincidental with the menopause

Before the age of twenty-one years, the incidence of

[1] Joslin, E. P, Root, H F White, P, Marble, A The Treatment of Diabetes Mellitus Lea and Febiger, 1940, pp 44–45

diabetes is about equal in both sexes, during the next decade, there is a 20 per cent preponderance in females Between thirty five and forty four years of age, the incidence in females is higher by almost 60 per cent Between the ages of forty five and sixty four years, there are almost twice as many females with diabetes as males Statistically speaking, there are 4 53 cases of diabetes per 100,000 females in the United States population, and only 2 73 cases in males per 100,000 In other words, one woman out of every 45, and one man out of every 70 has diabetes at age sixty five and over Starting at sixty five years, the difference in sex ratios diminishes until age eighty five is reached when the incidence in both sexes, as in youth, is similar [1]

IMPROVEMENT IN DIAGNOSTIC FACILITIES

With increased education of the public, more persons are reporting routinely to physicians and clinics for physical examinations Most industrial plants and business firms which offer retirement pensions to their employees require physical examinations yearly Civil service appointments also are preceded by physical examinations Although most public schools do not yet include urinalysis in the physical examinations given to students, many private schools and most colleges do These factors alone have contributed to an increase, not in diabetes, but in diabetic case findings

Statisticians and authorities agree, however, that many cases of diabetes still go unrecognized, particularly in rural areas where the ratio of physicians to patients is inadequate, and where diagnostic facilities are not readily available Obviously, if every individual were to have a complete physical examination annually despite the absence of diabetic symptoms or known diabetic

1

heredity, or if every patient who consulted a physician or dentist for treatment of any kind were to have his urine examined for sugar, the diabetic morbidity figures would show an even more marked increase Blotner and Hyde demonstrated this fact in a report of their examinations of service selectees in Massachusetts Among selectees examined, they found an incidence of 2 diabetics per 1,000 in the age group of eighteen to twenty-five years, 3 5 diabetics per 1,000 in the age group between twenty-six and thirty years, 6 2 per 1,000 in the age group between thirty-one and thirty-five years In this series of young men, 78 per cent of the diabetics were unaware of their disease These specific rates differ widely from the crude rates of the National Health Survey which are based on door-to door questioning without physical or laboratory examination According to the National Health Survey, there were only 0 6 diabetics per 1,000 in the age group between fifteen and twenty-four years, and but 0 9 diabetics per 1,000 in the age group between twenty-five and thirty-four years The report of Blotner and Hyde demonstrates that careful diagnostic research will reveal a far higher incidence of diabetes than would be expected in door-to-door questioning The incidence of recognized diabetes should be highest, then, in those urban areas where clinics and laboratories are most plentiful

RACE

Except for the Jewish race, in which the high incidence of diabetes has long been an established fact, there is no particular race or nationality characterized by an exceptionally high incidence or a relative absence of the disease diabetes Since members of the Jewish race rarely intermarry with members of other races, their higher inci-

dence may be the result of racial inbreeding Immigrants or offspring of European stock develop diabetes in this country even though none of their forebears were known to have the disease Again, this mirrors the longer life span, and better diagnostic facilities

DIABETES AS A CAUSE OF DEATH

In 1900, diabetes ranked twenty-seventh as a cause of death However, even though this disease has advanced from twenty-seventh in 1900 to seventh place during forty years, the increase becomes less pronounced when the formula for determining the crude death rate is adjusted to accommodate the shorter life span in the year 1900 Therefore, the fact that diabetes now ranks seventh as a cause of death does not necessarily represent a true increase in the prevalence of diabetes per se, but rather reflects a structural change in the longevity of the population, together with the availability of improved diagnostic facilities, better education of the public, and an arbitrary method of classifying joint causes of death

Figures derived from death certificates, based on varying interpretations of classifications, are subject to many errors Frequently, the sources of these errors are unavoidable For example, a physician may be called to treat a patient in extremis whom he has never seen before If the patient were to expire suddenly of arteriosclerotic heart disease, and his family not to mention his diabetic status to the physician, then the cause of death as stated on the death certificate would be arteriosclerotic heart disease without mention of an existent diabetes

In writing death certificates, priority is given to the underlying cause of death, and secondary causes then listed Thus, if a diabetic were to die as a result of trauma, the word diabetes might be withheld intention-

ally from the death certificate by a physician since the actual cause of death seemed unrelated to diabetes Another physician might conclude that the accident could have occurred because the patient was having an insulin reaction, and he would then list diabetes on the death certificate

If an unconscious patient were to enter the hospital with a laboratory diagnosis of diabetic coma, and a postmortem diagnosis of cerebral hemorrhage, the physician's difficulty in deciding the cause of death becomes obvious

Although annually there are about 35,000 deaths reported with diabetes named as the primary cause, and 4,000 additional deaths in which diabetes is listed as a contributing cause, the shortcomings of conclusions based upon these figures are manifest

LIFE PROGNOSIS IN DIABETES

Many factors contribute to the favorable or unfavorable prognosis of diabetes in individuals The severity of the disease itself is secondary to the patient's own emotional, intellectual, and economic components Dr Joslin has said that less than one-third of all diabetics are fairly well treated, one-third are moderately well treated, one-third poorly treated, and that one rarely sees a diabetic patient who is treated 90 per cent as well as modern methods make possible

Education of diabetic patients is essential to favorable prognosis, but the combination of excellent prescription and admirable teaching cannot always cope with a low rate of intelligence or with a long-persistent and structural type of emotional instability which some individuals present However, education of the patient is still the most satisfactory and tangible approach to the prolongation of diabetic lives

Since diabetic coma, the result of a break in continuity of established treatment, is always preventable if the patient has been well instructed, the incidence and the death rate from coma in a community are a reliable index to the adequacy or inadequacy of its diabetic teaching program When a known diabetic is hospitalized with the diagnosis of diabetic coma, one should be reluctant to place blame on the patient for his seeming lack of cooperation, rather, the teaching program should be evaluated first If, on questioning, the patient can recall that during his instruction period he had been impressed with the fact that he should never omit his insulin except on his physician's prescription, then one may justifiably question the patient's cooperation should he enter in coma with a history of insulin omission

The diabetic had a markedly shorter life span than average in the pre insulin era, but since the discovery of insulin the difference between diabetic and nondiabetic life tenure has slowly diminished Formerly—even as late as 1945—it was impossible for a diabetic to obtain life insurance because his life span was two-thirds that of normalcy In 1946, life insurance was granted to diabetics by one of the largest insurance companies in the United States This fact alone establishes the authenticity of the statement that the diabetic's prognosis for life now approximates that of the nondiabetic

CAUSES OF DEATH IN DIABETES

The fallacy of evaluating death certificates to determine the underlying causes of death in diabetic patients has been mentioned, but the number of conclusions based on pathological or postmortem examinations is surprisingly limited Robbins and Tucker of the Mallory Institute of Pathology at Boston City Hospital have presented

one of the most clarifying surveys on this subject Boston City Hospital, a municipal institution, serves a large metropolitan area The hospital accepts patients in the various economic levels between indigency and opulence, together with patients having numerous ramifications of diseases, and patients in emergent and terminal stages of these diseases Robbins and Tucker's study is based on

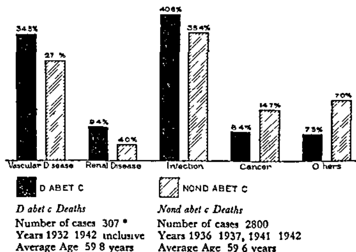


Fig 1 Causes of death in 307 diabetics and 2800 nondiabetics (Data from Robbins S L and Tucker A W, in New England Journal of Medicine Dec 28 1944)

the postmortem examinations of 307 consecutive diabetic cases, and a control series of 2800 nondiabetic cases The age at death is essentially parallel for both groups, 59 8 years for the diabetic series and 59 6 years for the control series Since diabetic coma is a hazard peculiar only to diabetics, the number of deaths from coma (22, or 7 2

* This figure includes 22 deaths from diabetic coma which are not used in this comparison since diabetic coma is peculiar to diabetes

per cent) was excluded from the total number of diabetic deaths in order to establish a more accurate comparison with the control group The authors selected for consideration those conditions responsible for the greatest number of deaths in the general population as well as those specifically associated with diabetes (Fig 1)

INFECTION

Infection, with a predominance of the pulmonary type, caused the greatest number of fatalities (Fig 1) This finding is higher than would be expected now because the series started before the introduction of chemotherapy, also, Boston City Hospital admits a proportionately large number of patients with newly diagnosed pulmonary tuberculosis in whom the tissue changes are too advanced to be reversible (Fig 4)

VASCULAR CHANGES

Vascular changes (Fig 2) appear second to infection as a cause of death in this series, but in most series the number of deaths of vascular origin would exceed those from infection The secondary position, in this instance, is influenced by the fact that a significant number of deaths, vascular in origin and sudden in occurrence, are referred to the office of the medical examiner Such a procedure automatically excluded an appreciable number of cases from the study This study corroborates the fact that coronary occlusion causes more than twice as many deaths in a diabetic group as in a nondiabetic one In this series, peripheral vascular disease was not seen in the large group of nondiabetics, but its relatively high incidence in diabetics is proverbial and further reflected by the marked increase in number of infections of the extremities which is seen in the diabetic group (Fig 4)

RENAL DISEASE

Although deaths from renal dısease represent a small fraction, they are sıgnıficant because twıce as many dıa

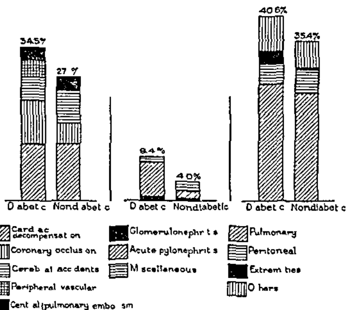


Fig 2 Fig 3 Fig 4

Fig 4 Infection as a cause of death in 307 diabetics and 2800 nond a betics (Data from Robbins S L and Tucker A W in New England Journal of Medicine Dec 28 1944)

betics as nondiabetics died of renal disease Acute pye lonephritis accounts for this marked variance, and sub stantiates the physician's reluctance to order catheteriza tion for diabetic patients except as a last resort (Fig 3)

CANCER

Also of statistical significance is the lower incidence of cancer in the diabetic series (Fig 1) Since the average age at death in both groups is almost identical, the lower incidence of cancer among diabetics cannot be ascribed to the fact that they did not live to reach those age levels at which cancer is most commonly found A conjectural conclusion is offered to the effect that the metabolic and endocrine abnormalities associated with diabetes contributed to the lower incidence of cancer

CONCLUSION

Robbins and Tucker concluded, from their comprehensive study, that the diabetic individual lives as long as the nondiabetic, but that there are certain hazards which he is more likely to encounter, namely, coronary occlusion, peripheral vascular disease, infection of the extremities, and acute pyelonephritis

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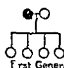
ETIOLOGY AND PREVENTION OF DIABETES

DIABETES MELLITUS is transmitted as a Mendelian recessive trait According to the Mendelian hypothesis of heredity, the heterozygous or unlike traits of two mates do not fuse in their offspring Instead, the predominant one leaves its mark and the recessive one tends to disappear or become latent until future mating revives it in another generation In discussing the inheritance of diabetes, three types of individuals are involved There is

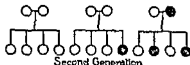
both parents, there is the heterozygous individual who represents a fusion of genes from one parent who carries the diabetic trait and one who does not, or two parents who do not have the disease but who both carry the trait or one parent who has the disease and one parent who carries the trait The heterozygous individual does not necessarily develop diabetes, but he carries the trait and may transmit it to his offspring There are three types of mating which may produce diabetic offspring first, if two carriers marry, 25 per cent of their offspring could develop diabetes, second, if a carrier and a diabetic marry, 50 per cent of their offspring could develop diabetes, third, if two diabetics marry, 100 per cent of their

offspring could develop diabetes From the last combination, which is indisputably the worst, only 44 per cent actually develop the disease, but as the life span continues to lengthen, this percentage should increase

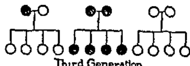
These conclusions are based on the work of White and Pincus, who postulated the genetic etiology of diabetes Similar or identical twins offer the most ideal situation



Mating of diabetic person with person who does not have diabetes or the trait for it The first generation of such a mating could not develop diabetes but all members of the first generation are heterozygous nondiabetics or carriers of the diabetic trait



Whether or not diabetes will *occur in the second generation* depends upon the mates selected by the first generation



The results of the three possible types of matings of carriers of the diabetic trait are shown The diabetic trait may have disappeared by the third generation or it may be revived according to the matings from the second generation

● – Homozygous diabetic
○ – Homozygous nondiabetic
○ – Heterozygous nondiabetic or carrier

Fig 5

for the study of inherited patterns since they represent the same germ plasm in duplicate The occurrence of diabetes in one of similar twins should predict its appearance in the other twin Joslin reported one series of similar twins in which 63 per cent of the sets had developed diabetes at the time of his writing This contrasts convincingly with his series of dissimilar or fraternal twins *in whom only 7 per cent of the sets developed* diabetes

SECONDARY FACTORS

Although a diabetic heredity is considered to be the prime factor in the etiology of diabetes, there are secondary factors which seem to precipitate the onset of the disease in those individuals who are hereditarily predisposed Chief among the provocative factors are obesity, trauma, infection, and emotional experience which is great enough to change the individual's mode of living It is generally agreed that none of these factors actually could produce diabetes, but that one or more of them could intensify a mild unrecognized diabetes to that degree of severity which would permit clinical recognition

OBESITY

The exact relationship of obesity to diabetes is not known or understood, but of great importance is the fact that obesity has been present in the case histories of 70 to 90 per cent of all diabetics with onset in adult life Dr Joslin's experience reveals that about 80 per cent of this obese group was markedly overweight In a series of 1,000 consecutive diabetics, he found 8 per cent who were underweight, 15 per cent who were of normal weight, and 77 per cent who were overweight For this reason, it is not surprising that obesity formerly was considered to be the chief cause of diabetes, and that this theory concerning etiology was widely accepted until the status of heredity was established It is known now that diabetes cannot occur as a result of overweight unless the inherited trait for diabetes is present

However, it is the responsibility of the nurse in her capacity as health teacher to stress and teach the dangers of obesity She must find a simple, nontechnical way to teach people who are overweight even when they can

recall no diabetic relatives It is true that the fat person of middle age usually cannot be impressed on the basis of maintaining a fashionable figure, and that he represents a real challenge for teaching skill long before he is presented with a lesson on low-calorie diet planning

Two points should be stressed for obese people whether they appear as patients or as friends or relatives of the patient

1 There is a shorter life expectancy for the obese person that for the leaner individual, whether or not he has diabetes

2 The hereditary trait of diabetes may not have shown up for several generations, but may appear if two carriers of the diabetic gene marry in any generation, and obesity may increase the chance of having diabetes

One of the factors leading to a shorter life expectancy in obese persons is the overburdening of the heart Patients should be made to understand that the heart acts as a pump in the body, and that when the individual develops a middle-age lateral spread which is out of proportion to his height, then his normal size heart must work harder and harder to take care of the circulatory needs of an expanding organism The technique of teaching in a simple conversational way, which eliminates terms like "hypertension" and "fatty degeneration" is essential Emphasis should be placed on factors which will be nearer to the layman's experience than "postmortem cardiovascular findings " For instance, everyone knows life insurance companies are anxious to sell policies, but most people do not know that insurance companies are unwilling to risk their investments by selling policies to overweight individuals because statistics reveal that the overweight person has an appreciably shorter life expectancy than does his leaner brother

Formerly, weight tables permitted the individual to gain several pounds for each additional year of his life, even up to fifty or sixty years of age All too often, this is the average experience, but there is no plausible reason for a person to weigh 10 pounds more at forty years of age than he did at thirty Such a gain merely represents the unfortunate result of eating more, doing less, or a combination of these two In using the type of table mentioned, one should consider himself to be thirty years of age or younger when determining an ideal weight for height after the thirtieth birthday

The second fact which must be appreciated in teaching these obese patients is that most individuals do not have a correct understanding of the term heredity, for when a patient newly diagnosed as diabetic comes to the clinic, where he is usually asked if there are other diabetics in his family, it takes persistent questioning to make the patient understand that inheritance concerns more than a direct parent-child mode of transmission With careful prodding, he usually recalls a great-uncle who died with a "diabetic foot," or a sister or cousin who "used to have sugar" Therefore, the teaching nurse should stress that diabetes which occurs even in distant relatives proves that the gene for diabetes is in the family, and that all overweight individuals in the family might then be potential diabetics Better still, she should teach all members of the family who are still of normal weight to avoid obesity Most diabetics develop their disease at forty-five to forty-nine years of age, but their surplus poundage started to accumulate between the ages of thirty and thirty-five years

The nurse herself should appreciate the fact that an excessive consumption of sugar alone does not precipitate the onset of the disease in the hereditarily predisposed

person, it is rather obesity caused by long exposure to excessive food in general that brings it on

TRAUMA

In a diabetic clinic, the relationship of trauma to the onset of diabetes is not impressive, but in the orthopedic ward it is striking Frequently a patient enters the orthopedic ward for treatment of a fractured leg, but when his urinalysis report comes back to the ward it reveals an unsuspected glycosuria A blood sugar analysis corroborates the diagnosis of diabetes, and the surprised patient finds himself receiving insulin and a special diet Immediately he decides that his diabetes occurred as the result of his fracture yesterday he had a normal leg and supposedly he was not a diabetic, today he has a fractured leg and diabetes Is it logical to assume that this patient did not have diabetes yesterday? Was his blood or urine examined for sugar yesterday, last week, last month, or even last year? Unless the patient answers in the affirmative, one cannot state with surety whether or not he did have diabetes before his fracture

Often, there are many indications present to support a belief that undiagnosed diabetes was actually present at the time of the accident For example, the patient may be about fifty years of age and he may be obese, and fractures are more common among diabetics than they are in a control group In the adult of middle age, the onset of diabetes is insidious, and the symptoms so benign as to escape recognition until some other complication occurs During this period, while the diabetes was unrecognized, the person might be in a mild state of acidosis, during acidosis, the ketone bodies which are lost in the urine take with them calcium, thus producing a rela-

tive calcium deficiency and predisposing the individual to bone fractures

As a cause of diabetes, trauma to the pancreas itself does not seem feasible because of the protection which the pancreas receives from its anatomical position At least four-fifths of the pancreas must be injured to produce diabetes Trauma sufficient to achieve this much damage to the pancreas would ordinarily damage surrounding organs severely enough to cause death

INFECTION

There is no proof that infection per se causes diabetes, although infection is known to alter carbohydrate metabolism Usually the patient who believes that an infection caused his diabetes did not have his blood or urine examined within a month preceding his infection and so, once again, the evidence is lacking Dr White reported that 90 per cent of a series of diabetic children who came to her for initial regulation of their diabetes did not have an infectious disease in the year preceding diagnosis This is a significant finding because although children are more commonly afflicted with infections than are adults, yet infection played an insignificant part in the onset of diabetes in childhood

Infection makes an existing diabetes more severe, and insulin requirements usually increase and regulation becomes difficult. Realizing this, one may appreciate the fact that an unrecognized, asymptomatic diabetes might quickly become severe enough for the patient to manifest symptoms following the development of an acute infection like pneumonia

At the onset of diabetes, while the disease is still mild and unrecognized, exercise often helps to "burn" or

metabolize the carbohydrate, because of this, the elevated blood sugar may rise to levels slightly higher than normal, but not to levels high enough to produce the classical symptoms of diabetes However, should an individual with this mild type of diabetes not only develop an infection, but one which is severe enough to put him to bed and thus eliminate his exercise, it is not surprising that his quiescent diabetes should become prominent After the infection has disappeared, this type of patient frequently develops a remission of his diabetes The nurse should teach him that a remission is not a cure Otherwise, the patient may return in five or ten years for thigh amputation, but with no personal account of diabetes except that sugar was once found in his urine Actually, if these patients were given glucose tolerance tests during their remissions, they would be found to have diabetes still Since these patients are discharged from the hospital as diabetics, the nurse should instruct them to report for blood sugar analysis at regular intervals of three to six months

EMOTIONAL EXPERIENCE

Emotional disturbance was once seriously considered as a cause of diabetes, but this theory is no longer tenable In those individuals who are hereditarily predisposed, an emotional factor might be significant enough to alter the mode of living to a degree that might precipitate the onset of diabetes For instance, people are often overweight, not because of an exaggerated sense of hunger, but because eating relieves their boredom or nervous tension This eating might be compared to the "nervous habit" of many cigarette smokers During the acute phase of an emotional shock, the person involved may not think of food in terms of routine meals, but instead he

may eat at odd hours either because he becomes restless or because someone reminds him to eat Eventually, as the acute phase of his emotional episode becomes less acute, he again eats his meals at the usual times, but he may retain the nervous habit of eating between meals to satisfy a residual restlessness The resulting obesity which follows, rather than the emotional experience itself, may favor the onset of diabetes if the person carries the trait for diabetes in his physical makeup

On the other hand, during a long period of emotional stress, the potential diabetic might eat significantly less food than he did normally, and his curtailed carbohydrate intake might not then offer adequate stimulation to an insulin secreting mechanism which has an inherent inadequacy If this person should once more resume his normal eating habits, the island cells might be unable to secrete insulin in the needed quantity All this is conjectural, however, and may not have any bearing on the etiology of diabetes

PANCREATITIS

Severe pancreatitis merits mention here Strangely enough, pancreatitis is rarely accompanied by diabetes Joslin reported the combination in one of every 22,258 cases, and Umber in one of every 1000 cases

HEMOCHROMATOSIS

Hemochromatosis, which is a relatively uncommon disease, may produce diabetes as a mechanical effect In hemochromatosis, which is a disease of metabolic origin, iron pigment is found in different cells of the body including those which make up the tissue of the islands of Langerhans The function of these island cells is lost when enough normal tissue has been replaced by iron

pigment, as the process extends, insulin cannot be secreted

SUMMARY

An inheritance of the trait for diabetes is the prime factor in the etiology of the disease For those who are hereditarily predisposed, obesity seems to be a precipitating factor, since 70 to 90 per cent of all adult diabetics are obese prior to the onset of their diabetes Trauma, infection, and emotion are often linked with the onset of the disease, not because any of these factors per se can actually cause diabetes, but because any one of them may intensify a mild or unrecognized type of diabetes

PATHOLOGY AND HISTORY

Although diabetes was described as a syndrome long before the time of Christ, the knowledge of diabetic pathology is relatively new In 1889, Paul Langerhans first described the cells of the pancreas which now bear his name, but he did not recognize their function or their association with diabetes

In 1900, Eugene Opie, who was then an instructor of pathology at the medical school of Johns Hopkins University, examined microscopically the islands of Langerhans from pancreatic sections of a child who had died in diabetic coma Gross changes are not visible in the pancreas of a diabetic at postmortem examination, but under the microscope Opie saw and recognized for the first time that the island cells were degenerated to such a degree that their identification presented difficulty

In 1916, Sir Edward Schafer postulated the theory that the islands of Langerhans secreted a hormone essential to the metabolism of carbohydrates Yet it was not until 1921 that this secretion insulin, was isolated largely through the efforts of Banting and Best

ANIMAL RESEARCH

Just one year before Opie's startling observation concerning microscopic degenerative changes in the islands of Langerhans, Oskar Minkowski produced severe diabetes in a dog by removing the entire pancreas, in a few weeks, the dog died of diabetic coma This episode marked the first time that diabetes had ever been produced deliberately in any species Minkowski's work focused the attention of investigators on the pancreas and undoubtedly paved the way for the research of others, including Opie and Schafer, who presented the theory that a qualitative or a quantitative deficiency of the hormone which we now call insulin is the immediate problem in diabetes

Diabetic research with animals has often produced interesting and striking results Different species respond to the same procedure in different ways Minkowski produced diabetes in a dog by complete pancreatectomy, yet recent work has shown that complete pancreatectomy in a duck does not produce diabetes We now know that diabetes will not occur in dogs if as little as one fifth of the pancreas is left in situ Careful evaluation of all animal experimentation must be stressed since not only do the results vary from species to species, but their application to man is not always feasible Yet one cannot belittle the findings of animal research since many of our present basic conceptions of diabetes are founded on the results of animal study Before insulin was used clinically, it was first administered to diabetic dogs, insulin lowered their blood sugar and favorably altered their diabetic syndromes just as it still does in human diabetics

Often many years are required to evaluate and interpret results of the animal experimentation which has been so prolific and constant in diabetic research

Houssay's experiments with dogs directed attention to the pituitary gland He produced severe diabetes in dogs by pancreatectomy, then he greatly ameliorated their diabetes by removing their pituitary glands When given an extract of the anterior pituitary these dogs developed severe diabetes once more This suggested that a pituitary hormone was associated with the disease diabetes

Young went further with this pituitary phase His dogs were normal ones which had not been subjected to pancreatectomy When these normal dogs were injected with crude anterior pituitary extract for a few days, their blood sugar levels were not significantly increased, but these animals did show a relative resistance to injected insulin as evidenced by the fact that hypoglycemia could not be produced in them However, Young did find that when normal dogs were injected daily over a long period of time, rather than for a few days, with the crude extract of the anterior pituitary, their blood sugar levels were definitely elevated to diabetic heights These dogs, too, were insulin resistant, but their diabetes eventually disappeared despite continued injections with anterior pituitary extract Unlike human diabetics, these dogs gained weight during their temporary diabetic-like phase The question arose Could obesity in the human prediabetic represent a parallel? Using a third series of normal dogs, Young injected larger and constantly increasing amounts of the anterior pituitary extract, following this program, the dogs did develop a true diabetes without remission and without insulin resistance

These experiments, almost half a century after those of Opie, directed attention to the effect of the anterior pituitary secretions on the islands of Langerhans, and presented several questions for discussion In the human

prediabetic stage, could an overly active pituitary have stimulated the island cells of the pancreas to produce more insulin than the individual required? Might this surplus of endogenous insulin have created and maintained a relatively low blood sugar level which could be alleviated only by a larger intake of food? Eventually, then, might these island cells "burn out" as a result of the extra demands made upon them, so that the result would be an obese individual who could no longer secrete insulin in sufficient amounts? If so, this is but one of several types of diabetes, for it does not explain why the diabetic child is rarely overweight Instead, he is characteristically overheight However, normal puppies do not develop diabetes when they are injected with anterior pituitary extract Instead, they are characterized by physical precocity, eventually growing to a greater size than that which nature planned for them After they have passed the puppy stage, they may develop diabetes even though their weight was never excessive

More recently, Dunn, Sheehan, and McLetchie, and Bailey and Bailey, and others have produced true diabetes in rabbits, dogs, and cats by the intravenous injection of alloxan, a component of the uric acid molecule Alloxan causes a specific and selective necrosis of the islands of Langerhans, while the acinar portion of the pancreas remains unaffected Death from diabetes occurs in these animals in one to five days Joslin feels that the significance of alloxan diabetes far outreaches other recent findings because alloxan is a component of uric acid which is a normal product of body metabolism Alloxan is also valuable because it provides a satisfactory and rapid way to produce diabetes in animals when special studies are desired concerning diabetic pathology

or complications, since a single injection of a 5 per cent solution of alloxan produces in these animals a diabetic state which will respond to insulin

Diabetes may, then, be produced in suitable animals in three ways (1) by removal of the pancreas, (2) by the injection of anterior pituitary extract, (3) by the injection of alloxan

PREVENTION

The problem of prevention is even more difficult to solve than is the problem of etiology which has at least one positive factor, that of heredity

If one approaches prevention of diabetes through publicizing the hereditary aspect, many discouraging obstacles present themselves First of all, the general public knows all too little about diabetes because the disease has not been given adequate publicity It is more common than tuberculosis, the prevention and treatment of which are largely sponsored by the public Millions of Christmas seals are sold each year to people who realize the need for funds in tuberculosis prevention and care, posters are found along roadsides, in public vehicles, and where people gather To finance research for the study of diabetes, there should be a "march of half dollars" since diabetes is five times as common as infantile paralysis Diabetes, too, leaves in its wake many disabling complications like blindness and loss of limbs It costs untold money on the part of the individual, the state and the city to finance the care and prostheses for crippled diabetics How much more useful and timely would it be to collect funds to finance research directed toward the prevention of these disabling complications and toward the prevention of diabetes itself!

It is startling to realize that more than 25 per cent of

the population carries the diabetic trait, yet the average person does not understand the significance of a diabetic heredity

A nurse who does public health work is the key person to teach the public Her contact is closer and more opportune than that of others, for she sees the patient in relationship to his family, meeting the healthy people of her community as well as the sick ones She should teach the young sons, daughters, nieces and nephews of her diabetic patients why they should not only avoid obesity, but why they should avoid the hazard of marrying into diabetic families

Frequently, the question of sterilizing diabetics comes up for discussion Sterilization is impracticable since the average diabetic has reared his family long before his diabetes is diagnosed Twenty five per cent of the population carries the diabetic trait, but there is no way of being absolutely sure which people are in this segment of the population

The most practical way to prevent diabetes resolves itself into two phases, both of which may be accomplished by teaching the younger members of the population who are not yet married or overweight to be aware of the situation so that they will recognize the significance of a double diabetic heredity and obesity High school students are not too young for this teaching since they have already learned of the Mendelian hypothesis in biology Such teaching would represent a practical application of this hypothesis Young diabetics should not be forbidden the normalcy of marriage Rather, they should be taught not to marry into a family where diabetes is present They should be impressed, also, with the importance of carrying on this teaching with their children, all of whom will inherit the trait (Fig 5) The nurse should teach

parents the need of instructing their children concerning the avoidance of marital partners who come of diabetic families

Except for preventing obesity, it seems futile to consider teaching the avoidance of other known precipitating factors such as emotion, trauma, or infection to those who are hereditarily predisposed to diabetes, but their true relationship should be explained to the diabetic who erroneously believes that one of them caused his diabetes Otherwise, attention may be diverted from the true cause, heredity

DIABETIC FUND

Where there is a group of diabetics, there should also be a diabetic fund The money for the fund should be derived in part from the diabetic patients themselves The existence of a diabetic fund enables the diabetic who has regained his health and who holds a useful position in society to help other diabetics likewise to gain prestige and morale

There is a need for solidarity and security by diabetics, but it should not be supplied through social functions Clubs established primarily for diabetic adults should be discouraged The common bond, diabetes, does not foster helpfulness and friendship so much as it does neurotic personalities Diabetics should be advised to remain with groups of normal people in order that they may adapt themselves to a normal life This is a direct challenge which cannot be met if the person joins social groups whose convening is primarily motivated by the presence of a disease

The uses for a diabetic fund are innumerable Research and education at large diabetic clinics speak for

themselves, but smaller funds in smaller communities are also valuable

At the Hartford Hospital the diabetic fund is relatively new It was established in 1942, and has not yet reached the sum of $500 Most of the money was donated by the patients in one-dollar bills One of the doctors, hearing of the fund, gave fifty dollars A women's club requested a talk on diabetic children, and then expressed its interest by conducting a picnic at which box lunches were auctioned The results were two a generous donation and an increased interest in diabetes in the community Another group of women asked for a talk on camps for diabetic children and this was followed by a contribution Twenty-five dollars is needed to send a diabetic child to camp for one week, although actually it costs much more to maintain the child for that time In the autumn and early winter, the parents and children are advised to start saving toward the expense of two weeks at camp The fund then supplies the deficiencies, which range from complete tuition to merely transportation costs The number of children is relatively small, but the greater amount of the fund is spent on them and rightfully so

The number of pregnant women with diabetes who are seen in the clinic is relatively small also, but the cost of estrogen therapy is a large item From the fund may come one-third of this expense

The diabetic amputee sometimes cannot afford to buy a pylon (weight bearing appliance) because he spent all his money futilely trying to save a toe Again the diabetic fund contributes something, if only enough to start the ball rolling by making a partial payment

The patients are greatly interested in this little fund

It belongs to them, and they frequently ask how it is being used Such a fund helps to publicize diabetes since most people who contribute tell their friends about it This does not usually mean more contributions to the fund, but it does seem to make more people aware of diabetes When the friend of a diabetic donor, who has neglected his own diabetes, heard how the diabetic fund provided ten dollars toward a pylon for a third diabetic who required a thigh amputation, he hastened to make an appointment with his own doctor This doctor corrob orated the story and he was quite impressed The establishment of a diabetic fund to which the patients may contribute, then, is of far reaching influence and of inestimable value

SUMMARY

Diabetes is a disease of genetic origin which is trans mitted as a Mendelian recessive trait In those who are hereditarily predisposed, the onset is believed to be hastened by the presence of obesity, since 70 per cent to 90 per cent of all adult diabetics are obese prior to the onset Obesity should never be overlooked or ignored The obese person who develops diabetes is really fortunate because by virtue of his diabetic diet he will lose weight and then he may evade the chance of developing heart disease and other complications which are asso ciated with obesity

The prevention of diabetes is a public health problem Teaching which will yield the most prolific results should be focused on the younger people between the ages of sixteen and thirty The aims, to prevent pairing the diabetic trait in marriage, and to prevent excessive weight which usually starts to accumulate after the thirtieth year, should be stressed

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III

ENDOGENOUS INSULIN

PHYSIOLOGY

Although it is impossible to determine the total number of insulin units normally secreted within the body, or to state with certainty the number of units required in the metabolism of a gram of carbohydrate, it is reasonable to assume that endogenous insulin is produced automatically and in varying amounts according to a diversified dietary intake and body needs Insulin is concerned primarily with the metabolism of carbohydrate foods, although it also metabolizes a portion of the protein and fat, and helps to maintain the blood sugar between certain recognized limits so that the normal person does not experience abnormally high or abnormally low blood sugar levels even when his diet is exceptionally high or low in caloric content

Insulin is essential for the formation of glycogen, an animal starch which is derived largely from the carbohydrate portion of the diet, more than 50 per cent of the protein foods, however, and about 10 per cent of the fat are potential glycogen also The conversion of glucose to glycogen is termed glycogenesis, that of protein and fat to glycogen, glyconeogenesis Approximately one-half of the body's glycogen is found in the liver, the storage depot for collateral carbohydrate If the normal individual omitted or delayed his noon meal, his blood sugar would not fall to an abnormally low level because

the glycogen which was formed from his breakfast would be converted to sugar and released into the blood stream and thus the blood sugar would remain within normal limits This process which involves the breaking down of glycogen to sugar is called glycogenolysis Glycogen is found not only in the liver, but also in muscles, which cannot function without it, and in other tissues

When the normal individual eats an excessive amount of carbohydrate food, he does not develop an elevated blood sugar Because his insulin is produced endogenously according to his needs, he merely produces insulin in sufficient quantities to convert the food into glycogen If the glycogen depots were filled, this surplus carbohydrate would be converted into adipose tissue, and the person would gain weight if his physical activity were not increased proportionately

One may, then, appreciate the problem which confronts the diabetic person whose lack is that of endogenous insulin, for without insulin he cannot form glycogen which is essential to all physical activity and thus to life itself

SYMPTOMS OF UNTREATED DIABETES OR HYPOINSULINISM

ONSET

The onset of diabetes may be gradual, sudden, or rapid Those in whom the onset is gradual are usually the middle-aged, overweight patients whose diagnoses are often accidental or incidental, their symptoms are so mild that they may suffer no inconvenience until one of the diabetic complications appears Younger patients more often experience either a sudden or rapid onset in sudden onset the symptoms are described as existing for weeks rather than months, in rapid onset the symptoms are described as existing for days or hours

SYMPTOMS

There is a triad of symptoms by which diabetes has been described for centuries Mention is made of them in the Ebers papyrus of the ancient Egyptians These three symptoms are polydipsia (excessive thirst), polyuria (frequency of urination), and polyphagia (excessive appetite) In the patient's history, the physician frequently refers to them as the "polys" The patient who has mild diabetes which has developed gradually may deny the existence of these symptoms, but will often admit that he has always been a drinker of large quantities of water

The two symptoms of polyuria and polydipsia are responsible for the term diabetes which is derived from the Greek language, liberally translated, diabetes means to "siphon through" Later, the qualifying word "mellitus," which is the Latin word for honey, was added when sugar was recognized in the urine voided

Polydipsia In severe diabetes this symptom presents a dramatic picture The patient tells of drinking consecutively five to six glasses of water and stopping, not because his thirst was satisfied, but because he could hold no more, and then, in a matter of minutes, having to repeat the process for relief of his thirst Such a degree of thirst indicates an extremely high blood sugar which in turn means that the person is producing relatively little endogenous insulin Since the individual is not secreting enough insulin for glycogenesis or glyconeogenesis, the carbohydrate remains in the blood as glucose Because it cannot be converted into usable glycogen, the glucose in the blood stream increases to abnormally high levels The symptom of thirst here represents a defense mechanism of nature, an attempt to dilute the excessive blood sugar so that the kidneys may eliminate what the body

cannot use It is conceivable that the kidneys could not eliminate a urine of syrup like consistency

Polyuria The symptoms of polyuria logically follow polydipsia In untreated diabetes mellitus, the large volumes of urine voided contain a varying amount of sugar Untreated diabetic patients may lose as much as 500 grams, or more than a pound, in twenty four hours, and each gram of sugar represents a loss of 4 calories

Polyphagia Polyphagia is less readily mentioned or recognized as a symptom by the patient In fact, its presence may influence the patient to delay his visit to the physician because a good appetite is associated usually with good health Since the patient is losing much unassimilable food as sugar in the urine, hunger is an expected symptom

This triad of symptoms forms a vicious cycle The higher the level of blood sugar, the more intense is the thirst The more fluid the patient drinks, the more he voids In this large volume of urine are lost potential calories and other nutriments, his hunger, therefore, is extreme The hungrier he becomes, the more he eats, and the higher goes his blood sugar, and so the picture goes on During this time, the patient loses weight and strength despite his enormous appetite

When the diabetic receives exogenous insulin to substitute for his own lack, these symptoms disappear if the correct diet is prescribed and followed Injected insulin, which is truly a substitute and not a real replacement, is prescribed in a dose which consists of a specific number of units, this exogenous insulin lacks the quality of automatic production which characterizes endogenous insulin, and therefore the diet cannot vary from day to day, but should remain constant in its content of available carbohydrate

CRITERIA OF DIAGNOSIS

A knowledge of the blood sugar level is essential to establish the diagnosis of diabetes mellitus

NORMAL BLOOD SUGAR

In a nondiabetic person the blood sugar fluctuates within accepted normal limits, regardless of the dietary intake because of endogenous insulin If the food intake is excessive, the body merely produces more insulin to convert the excessive food into glycogen, and possibly to adipose tissue, *but sugar does not accumulate or mount* in the blood On the other hand, if the individual has an inadequate food intake, his blood sugar does not fall to abnormal levels Instead, the carbohydrate reserve of glycogen is released by the liver in an amount necessary to maintain the blood sugar at a level which varies from 80 to 120 milligrams

When a patient presents himself to the physician or to the clinic with what are believed to be the classic symptoms of diabetes, a blood sugar examination should always be made A diagnosis of diabetes cannot be made because of the presence of glycosuria alone since glycosuria does not always indicate an insulin deficiency This subject will be discussed more fully in Chapter IV

The normal blood sugar content is between 0 08 and 0 12 per cent *When the report of a blood sample comes* from the laboratory, it is usually stated in terms of milligrams per 100 cc of blood Thus, 0 08 per cent becomes 80 milligrams per 100 cc, and 0 12 per cent becomes 120 milligrams per 100 cc

CAPILLARY BLOOD SUGAR

Capillary rather than venous blood is used frequently now for blood sugar analysis, for a prick of the ear lobe causes less apprehension than does a venous puncture

Obviously, a smaller amount of blood is required, for this reason, analyses which are performed on capillary bleedings are called "micro" determinations The ear lobe is preferred to the finger because puncture of the ear lobe carries less danger of contact infection If a sample of capillary blood were obtained while the patient was fasting, the sugar content would be almost identical with that of blood derived from a vein After food has been taken, the blood obtained from the capillaries would be somewhat higher in sugar content than blood taken from a vein Actually, if the reading on postprandial capillary blood were 180 milligrams, that taken from a vein at the same moment would be approximately 150 milligrams This difference of about 30 milligrams may be deducted reasonably when the patient is having a routine check-up, or at almost any time except when there is a question of diagnosis

VALUE OF POSTPRANDIAL BLOOD SUGAR ANALYSIS

Joslin describes diabetes as a chronic, hereditary disease characterized by an elevation of blood sugar and the appearance of sugar in the urine Thus, a diagnosis of diabetes should never be made merely because sugar appears in the urine When sugar does appear in the urine, the patient deserves a blood sugar analysis For instance, if a patient comes to the clinic because he has a pain in his chest, and the routine urinalysis reveals sugar, the clinic may ask him to return again for a fasting blood sugar test This might prove unfortunate because mild diabetics have normal blood sugar values in the fasting state his diagnosis would be missed, and he would be in danger of developing the complications of diabetes

There is another hazard to which such a patient might be exposed When sugar appears in the urine, the patient

is sometimes placed on both diet and insulin although he may not be a diabetic Such an erroneous conclusion would inconvenience but not harm the patient A more revealing procedure would be that of taking blood after the patient had eaten a meal high in carbohydrate This provocative procedure would show more conclusively whether or not the patient were producing sufficient endogenous insulin

TWO LEVELS OF BLOOD SUGAR

Generally there are two levels of blood sugar which are stressed for diagnostic purposes An individual with sugar in his urine may be considered to have diabetes if the fasting blood sugar is higher than 129 milligrams per 100 cc , or when the postprandial blood is higher than 169 milligrams per 100 cc of venous blood

GLUCOSE TOLERANCE TEST

If the postprandial blood sugar level is not conclusive, a glucose tolerance test is used to determine whether or not the patient has diabetes This test may also be of academic interest, but it offers no clue to the severity of the disease and is of no assistance in determining insulin requirements

There are many factors which must be taken into consideration before the test may be used, otherwise there may be a fallacy in the interpretation of results and the patient may be considered diabetic when actually he is not A glucose tolerance test is of questionable value if the patient has been living on a restricted diet for any reason For example, occasionally a question of whether or not true diabetes exists comes up even after a patient has been dieting and taking insulin for several months or years, this patient would not be a good candidate for

the glucose tolerance test, without careful preparation, for two reasons

1 Any restricted diet, whether diabetic, high fat, low caloric, or any other type except high carbohydrate, would, by its restriction, depress temporarily the need for endogenous insulin If 100 grams of glucose was given to a person whose production of endogenous insulin had suffered from lack of stimulation, his blood sugar might rise to abnormal levels The individual, therefore, who has been living on a restricted diet for any reason should be placed on a house diet with no restriction of carbohydrate for at least three days before he is subjected to a glucose tolerance test This period of normal eating would enable the insulin-producing mechanism to stabilize itself to the fluctuating dietary intake of normalcy

2 Should a patient whose condition has been erroneously diagnosed as diabetes be taking insulin when he does not actually require it, the production of his endogenous insulin is depressed even more than it would be if he were on diet alone If diabetic diet and insulin were not omitted until the day of the tolerance test, 100 grams of glucose would be too great a handicap for the markedly depressed secretion of endogenous insulin, and an abnormal elevation of blood sugar might easily occur after the ingestion of glucose The glucose tolerance test, then, should not be done unless insulin has been omitted for several days If the patient really has diabetes, such an omission would not be without danger If the diet and insulin are to be omitted in preparation for a glucose tolerance test, the patient should be kept under hospital scrutiny lest he go into a state of acidosis A patient with severe diabetes does not need a glucose tolerance test to establish his diagnosis because his postprandial blood sugar level would be diagnostic

In Chapter II it was mentioned that infection disturbs carbohydrate metabolism All infections are not obvious, and it is not always possible to determine whether or not the patient with questionable diabetes has an occult infection The elevation of body temperature may desig nate that the patient has an infection Therefore, the nurse always takes the patient's temperature in preparation for a glucose tolerance test, the test is usually can celled if the temperature is elevated

The Metropolitan Life Insurance Company has pub lished a report based on the clinical aspects of diabetic patients studied at the George F Baker Clinic in which it is stated that "the glucose tolerance test is an abnormal procedure, influenced by age, previous diet, previous insulin, infection, nondiabetic conditions pregnancy, arthritis, endocrine disorders, cancer, liver disease, and others" It is obvious, then, that the test should be done only as a last resort, in the absence of certain complications and conditions

TECHNIQUE OF GLUCOSE TOLERANCE TEST

There are several standard methods of doing a glucose tolerance test, but only one will be described here The patient is instructed to take no food after midnight on the day of the test In the morning, samples of blood and urine are collected while the patient is fasting Next, the patient is given glucose by mouth, for the adult, 100 grams of glucose is dissolved in 800 cubic centimeters of water which is flavored with lemon juice to make the solution more palatable The patient is instructed to drink the entire amount at once Samples of blood and urine are collected simultaneously at intervals of one-half hour, one hour, two hours, occasionally again in three hours, following the administration of glucose

Normally, there should be no glucose found in the urine because the automatic production of endogenous insulin should be sufficient to convert the glucose to glycogen The blood sugar will rise, normally, to a level which is higher than the fasting one, but not to a level of 170 milligrams Within two hours, the blood sugar level should drop to approximately the fasting level If the patient has diabetes, his blood sugar might or might not reach a fasting level of 130 milligrams, but the blood sugar following the intake of glucose would rise to a higher level than 170 milligrams, and the last blood sample collected would not be so low as the fasting level To make the diagnosis complete, at least one sample of urine collected after the ingestion of glucose must contain sugar

PLAN OF ACTION

The situation resolves itself into the following plan when a patient is thought to be diabetic because of the presence of sugar in his urine If possible, blood sugar analysis is performed at the first visit to the clinic If this test is not conclusive for diagnosis (higher than 129 milligrams if the patient is fasting or higher than 169 milligrams if the patient has eaten) the patient is not advised to restrict his diet in any way, but he is asked to return to the clinic about an hour after he has eaten a high carbohydrate meal Following this procedure, if the postprandial blood sugar reaches or exceeds the diagnostic level, treatment for diabetes would be prescribed

CONCLUSION

In conclusion, the patient with sugar in his urine is usually considered to be a diabetic until careful and cautious blood sugar tests rule out the absence of diabetes

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IV

EXAMINATION OF URINE

QUALITATIVE AND QUANTITATIVE TESTS

HISTORICAL FACTS

The macroscopic study of urine is an old one as is evidenced by the fact that Galen (131–201 A D.), who believed diabetes to be a disease originating in the kidneys, wrote several interpretations regarding the color of urine, which were based on his own observations He was concerned not only with the color but with the quantity of urine voided, and thus he recognized diabetes by the presence of polyuria

To Thomas Willis (1664) is given credit for realizing that there was sugar in the urine of diabetic patients His conclusion was not founded on scientific proof, but on his practical observation that the urine of diabetic patients had a sweet taste

The first person to do quantitative tests for urinary sugar was Matthew Dobson, in 1776 He was also the first person to record that the blood plasma of diabetic patients tasted sweet

In 1847, Markwick published the first book on urinalysis, establishing the application of urinalysis to the field of diagnosis in medicine In this physician's handbook, Markwick described two ways to detect sugar in the urine by the process of fermentation, and by the reduction of copper Reduction of copper is still the basis for most tests in the search for glycosuria

In 1848, Fehling introduced a copper solution test which was simpler to perform than was Markwick's method Fehling's solution is still used, but not so widely as it was two or three decades ago

By 1940, most of the hospitals and clinics in this country were using the Benedict test Benedict introduced his method in 1911, the Benedict test is a copper reduction method which is simpler to perform than the Fehling test because it requires just one solution and the Fehling test requires two

BENEDICT TEST

Although the Benedict qualitative test for sugar is simple to perform, it should be done with absolute accuracy to guarantee uniformity of interpretation

PROCEDURE

The Benedict test is done as follows

1 Put 5 cc (approximately 1 teaspoon) of Benedict solution in a test tube
2 Add exactly 8 drops of urine The dropper must be clean and the tip intact If the tip is broken, the size of the drops will be too large, and thus the amount of urine will not be in correct proportion to the amount of Benedict solution The dropper should be held at a 45-degree angle (Some authorities teach that the urine should be placed in the tube first and the Benedict solution added last Because most people do not measure the solution with a pipette or teaspoon, this method has one disadvantage, for any degree of unsteadiness on the part of the pourer might mean more than the desired amount of Benedict solution, which would render the results useless If the addition of urine is reserved for the last step, an excess

of Benedict solution could merely be poured back into the container)

3 Shake the tube well to mix the urine and the Benedict solution
4 Place the tube into a boiling water bath
5 Remove from the boiling bath at the end of five minutes, and read the color change, if any, immediately.

INTERPRETATION

Any deviation from these five steps will interfere with the accuracy of interpretation because the color reaction determines not only the presence of sugar, but also the

TABLE 1

SIGNIFICANCE OF COLOR REACTION IN BENEDICT TEST

COLOR	CODE	APPROXIMATE % OF SUGAR IN URINE	APPROXIMATE BLOOD SUGAR
Blue	0	none	169 milligrams or less
Green	1+	0 1–0 9	170–200 "
Yellow	2+	1 0–1 5	200–230 "
Orange	3+	1 5–2 5	230–300 "
Red	4+	2 5–	300– "

relative amount of sugar present Table 1 indicates the approximate correlation between the color reactions of the Benedict test and the estimated percentage of sugar in the urine and blood

RESULT OF INACCURATE PERFORMANCE

If less than 8 drops of urine, or more than 1 teaspoon of Benedict solution is used, the urine will appear to contain less sugar than it actually does If more urine than 8 drops or less Benedict solution than 1 teaspoon is used,

the color reaction would then indicate the presence of a larger amount of sugar than if the test were done correctly To insure uniformity of procedure and reading, the amount of urine should be measured, never estimated

The water bath into which the tube is placed should be boiling, not merely simmering Hybrid color reactions, which are difficult to interpret, sometimes result when the tube is placed into a cold water bath and then allowed to reach the boiling temperature Occasionally, one sees the tube flamed over a Bunsen burner to save time, but there are several reasons why flaming is a less satisfactory procedure In flaming the test tube there is danger of burning the fingers or hand, breaking the test tube, or evaporating some of the liquid The boiling method is definitely better for the patient's use, and if the procedure for nurse and patient is identical, the possible difference of opinion in the interpretation of the test is lessened

The color reaction is noted immediately after the tube is removed from the water bath One does not allow it to stand to see whether or not sediment is present, for the sediment is of no value in interpretation If the nurse should forget to shake the tube before she places it into the boiling water bath, the result may be a thick orange precipitate at the bottom of the tube while the solution at the top is clear blue However, if the tube is shaken vigorously, the resulting color would in all probability be green, and this is the correct reading

GLYCOSURIA

Although diabetes should not be diagnosed merely because of the presence of glycosuria, it is obvious that diabetes is most often diagnosed because a urinalysis

revealed sugar However, sugar in negligible amounts, about 0 001 per cent, is believed to be present in the urine of normal people, but this small amount does not give a positive reaction to the Benedict test The amount of sugar normally found in the urine, then, is not revealed by ordinary methods of urinalysis, and it is not influenced by dietary intake, whereas the amount of sugar found in diabetic urine is directly influenced by the dietary intake A percentage of sugar as low as 0 08 per cent will reduce Benedict solution

RENAL GLYCOSURIA

When glycosuria is marked in the presence of normal blood sugar levels, the condition is called renal glycosuria, or renal diabetes The latter term is incorrect and meaningless True renal glycosuria is a benign condition, and needs no treatment A glucose tolerance test, correctly performed, will serve to diagnose the condition If individuals with renal glycosuria are given insulin in amounts sufficient to prevent the loss of glucose in their urine, then their blood sugar levels will drop so low as to be incompatible with normal living Dr Joslin reports a series consisting of 1996 patients with renal glycosuria seen between the years 1897 and 1935 Of this large series, less than 10 per cent developed true diabetes Patients who have normal blood sugars but constant glycosuria are not treated with diet or insulin They are instructed to avoid obesity, and to have their blood analyzed for sugar content at regular intervals

GLYCOSURIA IN PREGNANCY

Various authorities report that from 2 to 20 per cent of all pregnant women have glucose in their urine during the first two trimesters of pregnancy, before the time

when lactosuria might be expected Even when these women are found not to have true diabetes during pregnancy, they should be followed at yearly intervals for life

MELLITURIA OTHER THAN GLYCOSURIA

Several sugars other than glucose will give a positive reaction to the Benedict test These various sugars will reduce the copper of Benedict solution, and therefore give a false positive test for glucose Special laboratory tests will reveal and identify these sugars Generally speaking, a patient is said to have nondiabetic mellituria when the Benedict test is positive for sugar, and the blood sugar levels are normal The presence of these sugars does not require treatment Once the patient has been studied, his condition should be explained to him for two reasons first, so that he will present himself to his physician for routine check-up lest diabetes manifest itself eventually as a superimposed issue, and second, so that the patient will not be placed on a diabetic routine at some other time merely because the Benedict test revealed the presence of sugar in the urine

Lactose ($C_{12}H_{22}O_{11}$) is sometimes found in the urine of nursing mothers, or in the urine of infants who are breast fed Rubner's test for lactosuria is considered to be reliable and conclusive Rubner's test is a laboratory procedure

Pentose ($C_5H_{10}O_5$), which is found but rarely in urine, is not fermentable, but it will reduce the copper of Benedict solution even when the solution is not exposed to heat Some clinics routinely do the test for pentose and glucose simultaneously at the patient's first visit This is done by adding 8 drops of urine to 1 teaspoon of Benedict solution Then the contents of the tube are divided One tube is placed into the usual boiling water

bath for five minutes, the other tube is allowed to stand at room temperature for at least six hours If pentose is present, the unheated specimen will reduce the Benedict solution at room temperature Pentosuria requires no treatment other than instructing the patient so that he will avoid an erroneous diagnosis of diabetes, or so that the diagnosis of diabetes will not be overlooked should it develop after an interval Pentosuria is believed to be present only in male members of the Jewish race

Fructose ($C_6H_{12}O_6$) not only reacts to the "cold test," but it is fermentable There have been about 40 cases reported in the literature, and the condition is obviously quite rare In the laboratory, the Selivanoff test detects it Fructosuria is believed to represent an inborn error of metabolism, and it requires no treatment

Maltose ($C_{12}H_{22}O_{11}$) rarely occurs in human urine

Sucrose ($C_{12}H_{22}O_{11}$) is never found in urine unless the sugar has been given intravenously

CONCLUSION

When sugar is found in the urine of a patient, he does not necessarily have diabetes mellitus, although, statistically speaking, he does more often than not Difficulty in diagnosis is not a problem in the moderate or severe diabetic for his symptoms of thirst, frequency, and weight loss, accompanied by glycosuria leave little doubt in the physician's mind However, even in the presence of such symptoms as polyuria and polydipsia, a blood sugar corroboration is essential when diabetes is suspected Another condition which is characterized by polyuria and polydipsia should be mentioned at this time, namely, diabetes insipidus Diabetes insipidus is caused by a hormonal deficiency of the posterior pituitary gland The disease derives the term "diabetes" meaning

to syphon, because of the symptoms polyuria and polydipsia However, the urine of a patient with diabetes insipidus is free from sugar as indicated by the term "insipidus" which means tasteless The patient with diabetes insipidus does not lose weight because there is no loss of nutriment, such as sugar, in the urine

TEACHING THE DIABETIC PATIENT

Since diabetes is a chronic condition, the diabetic patient must be taught not only all that he can absorb concerning the disease, but also how to apply this knowledge profitably so that his health will be restored and maintained On the nurse falls the greatest responsibility in this teaching program At all times it must be borne in mind by the nurse that the patient's reactions and comments should be carefully noted To many patients the diagnosis of diabetes is a real blow, and their previous knowledge of the disease will be sure to color their thinking It may be necessary to interrupt the explanation of any procedure to clarify some preconceived idea of the patient

BENEDICT TEST

At the beginning of treatment, the patient may be overwhelmed at the prospect of much teaching directed toward him It is wise to use the Benedict test in the first lesson because it is so simple to perform, and its simplicity encourages him and puts him in a more receptive frame of mind for other instruction

PROCEDURE OF INSTRUCTION

First, the nurse instructs the patient to put a pan of water on the stove so that the water will be boiling at the right time, and explains that the material of which the

pan is made is of no consequence, but that one with a handle is ideal Then she instructs the patient to pass his urine into a clean receptacle The nurse then measures the correct amount of Benedict solution, using a teaspoon, since 1 teaspoon holds approximately 5 cc This amount she pours into a test tube After rinsing a medicine dropper several times in clear water to be sure there is no urine left from a previous test, she carefully adds, counting aloud, 8 drops of urine to the Benedict solution Then she explains to the patient that the dropper, in addition to being perfectly clean, must have no breaks in the tip to alter the size of the drops, and that it must have a rubber bulb which provides good suction Together, the nurse and the patient examine the water in the pan to be sure that it is bubbling, not just simmering At this point, they may decide to wait until the minute hand of the clock is at the start of a five-minute interval before inserting the test tube The timing element might be easier for the patient to remember if he started at 3 15 rather than at 3 13, for instance

During this five-minute period of boiling, the nurse should write out the steps of the procedure, reciting them aloud again to help the patient learn by the process of repetition If the patient has a handbook or primer on diabetes, the nurse writes her own instructions at the beginning of the book, or on one of the inner covers Instructions written on loose pages of paper are of no value since the patient usually mislays them A large notebook, however, serves the purpose admirably The nurse should select only the salient points or steps in the procedure for inclusion in the patient's book, for lengthy explanations are cumbersome and discouraging If the nurse's oral instruction has been adequate, these salient points will enable the patient to recall the rest A simple,

written explanation of the Benedict test would be as follows

```
Benedict solution   1 teaspoon
Urine               8 drops
Mix well by shaking tube
Put into bubbling water for exactly 5
  minutes
Results  Blue--no sugar (perfect)
         Green--small amount of sugar
         Yellow)
         Orange) too much sugar
         Red   )
```

A knowledge of how to do and interpret the Benedict test gives a diabetic patient his first real insight into the practical treatment of his disease He appreciates that he is making progress when the tests have a green reaction instead of an orange one, and the joy of achievement is really his when he becomes sugar-free

HOURS FOR COLLECTING AND TESTING URINE

The patient is instructed to test his urine before each meal at the beginning of treatment In the chapter on insulin, the need for these fractional tests will be discussed The patient is asked to bring a written record of his tests to the doctor at each visit A page in the patient's notebook may be ruled to improvise a chart The following is an illustration

Date	Before breakfast	Before dinner	Before supper
Jan 1	Yellow	Yellow	Orange
Jan 2	Orange	Green	Green

When the patient rises in the morning, the first urine voided (the so-called overnight voiding) is not actually his before breakfast specimen because this urine has been

in his bladder for many hours The urine which was formed up until midnight may have a large amount of sugar whereas the urine formed after midnight may have a lesser amount of sugar During the hours of sleep, there is a pooling of urine within the bladder For this reason, the nurse should instruct the patient to test the second specimen of urine passed before breakfast The same precaution must be observed for the other single or fractional tests Thus, if a sample of urine is required before supper, the patient should be taught to empty his bladder at about 3 30 P M Otherwise, that urine submitted at 5 30 P M will be a combination of urine formed postprandially and of that which was formed before supper Since the blood sugar tends to rise following meals, the urine formed at such a time might, for example, give a yellow reaction to the Benedict test The urine formed four hours after a meal might be entirely free from sugar Yet, the two pooled together into one voiding might give a green reaction to the Benedict test The nurse must explain the importance of these second voidings to the patient so that he will not fail to collect and test the samples at the right time

NEED FOR DAILY TESTING

Once the diabetic has had his dietary and insulin dosage established, he will ask how often he should test his urine The answer must vary from patient to patient, but there is one positive fact with which the nurse must impress the patient, which is that he must test the urine at least once a day Patients become careless of testing for one of two reasons usually First, when the test has been negative for a long period, the patient may decide that testing is a waste of time Such a decision is invariably followed by a gradually developed carelessness of attitude

in all matters pertaining to his diabetes, this careless attitude usually persists until one of the diabetic complications develops The second occurrence which motivates the elimination of urine testing is diet breaking When he breaks diet, the diabetic knows the test will give a positive reaction, so why test? The nurse should explain these pitfalls to the patient When he tests, even after he breaks diet, the orange or red reaction will disturb him enough to keep him from repeating his dietary indiscretion so readily the next time

TWENTY-FOUR HOUR SPECIMENS

Single or fractional tests help the doctor to determine the correct insulin dose, but because they give information covering a limited space of time and are merely qualitative in nature, they do not offer enough information For this reason, the doctor may ask the patient to save twenty-four hour samples of urine at intervals The nurse should write out the procedure in the patient's notebook Following is an example

1. Select a tightly covered bottle which holds about four quarts. Clean thoroughly with soap and water, and rinse well.
2. On the day of the test, empty the bladder at 7 A.M., but do not put this urine into the bottle.*
3. All the urine which you pass from that time on, however, including the specimen voided at 7 A.M. on the following day, goes into the bottle.
4. Keep the bottle in as cool a place as possible.
5. When the twenty-four hour specimen is completed, shake the bottle thoroughly to mix the urine.

...ally a part

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6. Carefully notice and record the exact
   amount of urine; that is, 2 quarts, etc.
7. Put about half a pint of the total mixed
   specimen into a bottle which has been
   thoroughly washed. This is particularly
   important if the bottle originally held
   a liquid.
```

If the above information is mimeographed or printed on a form, it can be pasted in the patient's notebook, but the nurse must still take the time to carefully read it aloud as she explains it to the patient She should never assume that he will understand the instructions by merely reading them Such a conclusion may delay progress in the end It is true that many patients will understand without assistance, but when one considers that most diabetics are over forty-nine years of age, that their cerebral arteriosclerosis tends to be more advanced than it is in nondiabetics, and that the emotional impact of the diagnosis may produce confusion and an inability to concentrate, then there is little question about the wisdom of a complete explanation In working with older patients, the nurse will notice that the ability of older people to learn is not necessarily impaired, but their memory frequently is They may understand and learn immediately today, but tomorrow the facts are forgotten Repetition of word and action seems to bring the best results in teaching them

VALUE OF INTERPRETATION

It would be difficult to say which is more important, the single or the twenty-four hour specimen of urine The twenty-four hour specimen, which is saved for the quantitative analysis of sugar, is examined by the laboratory technician whose report enables the physician to know exactly how many grams of sugar the patient is losing

in his urine The formula for determining the number of grams lost is as follows

Volume (cc) × percentage (of sugar) = number of grams lost

Thus, if the volume were reported as being 1 quart (or approximately 1,000 cc), and the laboratory technician reported that the sample contained 3 8 per cent sugar, the calculation would be

```
 1,000 (cc )
   038
  ----
  8000
 3000
 -----
38 000 grams of sugar
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However, if the volume were 4 quarts instead of 1 quart, and the laboratory report revealed the presence again of 3 8 per cent sugar, there would then be a loss of 152 grams of sugar The nurse, then, will see that a knowledge of the percentage of sugar is of little value unless the volume is known also A striking example of the need for this knowledge may be seen when the patient drinks excessive amounts of water, not because he is thirsty, but because he wishes to achieve sugar-free tests By drinking a large volume of water, he dilutes the urine just as surely as if he poured water into the urine Because a sugar-free test is symbolic of good progress, the patient may lose sight of what the test actually means If the nurse does not strive to protect the patient from this erroneous attitude, he may present himself at the clinic with a record of his single tests being green or sugar-free, and when the twenty-four hour specimen of urine is titrated, it may contain just 0 9 per cent sugar So far the record would look satisfactory However, if the patient had voided 4 quarts of urine, the calculation

would show a loss of 36 grams of sugar in twenty-four hours Most physicians do not like their patients to lose more than 10 to 15 grams of sugar in twenty-four hours Invariably, the question which now comes from the patient is, "How much water should I drink?" To this, the nurse may reply that he should drink enough water to insure a urinary output of 1½ to 2 quarts daily

It is obvious that the twenty four hour sample of urine reveals exactly how much sugar the patient is excreting, but the single specimen reveals at what time of day most sugar is lost

COMMERCIAL URINALYSIS TESTS

Before closing this chapter on urinalysis, it would seem essential to mention some of the commercial urinalysis sets which may be purchased by diabetic patients All of these sets have one advantage which appeals to the patient, they do not require a boiling water bath This is an exceedingly important fact to the patient because the idea of using the kitchen cooking stove for urinalysis may be embarrassing and distasteful to him

However, most of the commercial tests have at least one undesirable feature The most common fault is that the tablets used contain substances which are caustic to wet skin One set, in addition to using caustic tablets, calls for the measuring of fifteen drops of fluid After teaching older patients how to do the Benedict test, the nurse will be impressed by the unusual difficulty which some elderly patients experience in learning how to use a medicine dropper The peripheral neuritis, which so often accompanies diabetes, makes their fingertips less sensitive so that they have trouble in applying and releasing pressure on the rubber bulb This condition makes the measuring of fifteen drops a real problem

Another commercial set contains not tablets, but white powder with a bismuth base The amount of sugar is indicated by means of several shades of gray The Benedict test color reactions of green, yellow, orange, and red are more satisfactory for the average person These various commercial testing sets are used by younger patients without trouble, and they are ideal for traveling but their use should be reserved for those patients who understand their undesirable features



Fig 6 Test tube heater (D atest Laboratories)

An electric tester, which has been on the market for several years, is unquestionably superior because it does not involve the use of caustic substances This set consists of the heater itself and a pyrex test tube On the test tube is a black ring which indicates 2 5 cc Benedict solution is poured in up to this mark, and then four drops of urine added The tube is shaken and placed in the heater which does not contain water After the tube has been inserted, the cord is connected with the electric

current for exactly five minutes This electric heater, too, eliminates the need for testing in the kitchen Such a testing unit has several advantages The color reactions would be more universally understood by physicians everywhere since the Benedict test is the one most widely used Benedict solution is less expensive to make or produce than are tablets, and it may be purchased for about 50 cents a pint in almost any drugstore If approximately ½ teaspoon is required for the test, then more than 250 tests may be done with one pint of solution Benedict solution will keep at room temperature indefinitely, whereas tablets will crumble when they are exposed to dampness

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V

EXOGENOUS INSULIN

In 1916, Schafer suggested that the pancreatic hormone which regulates metabolism of carbohydrate be known as insulin Since the word *insulin* is derived from the Latin word for island, the term seemed appropriate and specific because the hormone is secreted by the islands of Langerhans of the pancreas In 1921, insulin was isolated mainly through the efforts of the late Dr Frederick Banting and his associate, Dr Charles H Best, at the University of Toronto

Insulin, which has never been prepared successfully as a synthetic drug, is a protein from which 9 amino acids have been separated and recognized Insulin for clinical use is derived from the pancreatic tissue of domestic cattle, primarily sheep, beef, and hog

INSULIN REQUIREMENTS IN DIABETES

In 1923, the Standards Commission of the League of Nations defined a physiological unit of insulin as that amount which would cause the blood sugar of a healthy 2 kilogram rabbit, which had been deprived of food for twenty-four hours, to drop to the level of 0 045 per cent within five hours

According to clinical experience and physiological experiments, diabetes is not complete, that is, all diabetics do secrete some insulin within their own bodies Because it is impossible to determine how many units of endogen-

ous insulin the diabetic is secreting, it is likewise impossible to calculate by any formula how many units of exogenous insulin will be required to control his diabetes The amount of carbohydrate in the diet or the individual's body weight does not offer the solution, but the physician's experience, together with some trial and error during a period of close observation, is necessary to determine the individual diabetic's requirements Although it is the physician's responsibility to order the dose of insulin, the nurse should understand the steps which lead to the calculation of the dose so that she may administer intelligently and teach constructively The nurse should always remember that the dose is variable even in the same patient, and that the efficiency of insulin is not doubled as the dose is doubled For example, the diabetic who takes 20 units of insulin may be under good control on a diet which contains 150 grams of carbohydrate, but 40 units of insulin will not enable him to tolerate 300 grams of carbohydrate The statement has often been made that the dose would have to be "squared rather than doubled" to achieve a doubled degree of effectiveness

Most diabetics deserve the benefit of insulin Patients who succumb to diabetes itself or to one of its direct complications are those from whom insulin has been withheld, or for whom the prescribed dose of insulin was inadequate for any reason, or those who try to rely on insulin alone and ignore the prescribed diet

TYPES OF INSULIN

There are four types of insulin on the market All these insulins are effective in that they lower the blood sugar and enable the diabetic to metabolize carbohydrate without appreciable loss, but some are considered to

be more ideal for clinical use than are others The insulins are broadly classified as slow-acting and rapid-acting

RAPID ACTING INSULIN

Regular and crystalline zinc insulin are rapid acting They are clear solutions which become effective almost immediately after injection, and are effective for a period of six to seven hours Multiple daily doses of rapid-acting insulin would be essential to establish regulation during twenty-four hour periods

Regular Insulin This is the original insulin of Banting and Best Until 1935, regular insulin was the only insulin which was available commercially Because a single dose was effective for approximately six hours, it was necessary to inject insulin before each meal Many patients took a fourth dose at bedtime, but the effect of this last dose did not always span the night Therefore, it was impossible for all diabetics in the Banting era to experience adequate control of their diabetes for twenty four hours daily Many of them, especially the juvenile patients with diabetes of long duration, awoke in the morning feeling ill because of unavoidable high blood sugar and acidosis which followed insulin depletion after 4 00 A M

Crystalline Zinc Insulin This form of insulin is used exclusively in most clinics now as the rapid-acting insulin of choice It appeared on the market in 1938 with the following information printed on the label "Insulin especially prepared as solution of zinc insulin crystals" The action of crystalline zinc is almost identical with that of regular insulin, but crystalline zinc is a more refined drug which is effective for about one hour longer than is regular insulin

SLOW-ACTING INSULIN

Since 1921, research workers had been trying to produce an insulin which would be liberated more slowly from the tissues than the regular insulin so that the inconvenience and discomfort which resulted from multiplicity of doses could be avoided To this end, regular insulin had been prepared in combination with vasoconstrictors, but this method of decreasing the rate of absorption was not appreciably effective Regular insulin was combined with oil, but since the resulting suspension caused many abscesses at the site of injection, this method was discarded Finally, Hagedorn, at the University of Copenhagen, introduced a successful protamine insulin which is the basis of our present protamine zinc insulin

Protamine Zinc Insulin The protein used is derived from the ripe sperm of the rainbow trout It provides a suspension which has a minimum degree of solubility After protamine insulin has been injected, the precipitate is slowly broken down, and insulin released in small quantities over a long period of time The original protamine insulin acted over a period of twelve to fourteen hours When zinc was added to it, the action was prolonged over a period of twenty-four to seventy-two hours, with the peak of action in twenty-four hours Protamine zinc insulin does not act effectively for the first few hours following injection Thus, a dose injected at 7 00 A M on one day does not become effective until noon of that day The action then becomes effective for the next twenty-four hours, or until noon of the following day This overlapping action is tapering, it may or may not be adequate enough to cover the period of inactivity of the day's dose of protamine zinc If it does not, crystalline insulin would be required to cover the hours between breakfast and noon

Although the action of protamine zinc insulin spreads out over a period of seventy two hours, any effect after twenty four hours is too minimal to maintain the patient adequately Protamine zinc insulin, now considered to be basic, is not withheld even when the patient cannot eat his usual diet, as may happen during surgery, for example Patients who take protamine zinc insulin have active insulin in their bodies constantly, and these diabetics awaken in the morning with normal blood sugar levels and without the handicap of mild acidosis

At the start of treatment with protamine zinc insulin, the action is not immediate but cumulative, and takes from three to five days or longer to accumulate Once accumulation has been accomplished, about 50 per cent of all diabetics can be regulated on protamine zinc insulin alone However, about 40 per cent of all patients, and 90 per cent of the juvenile diabetics require in addition a dose of crystalline insulin before breakfast to prevent a postbreakfast rise in blood sugar These two doses will supply the insulin needs of the diabetic for the next twenty four hour period except for rare instances

Protamine zinc insulin should be kept in a cool place because of its protein nature It appears as a suspension, and its precipitate should be distributed evenly before withdrawal from the vial, since the retarded action depends on the even distribution of the solid particles To distribute the precipitate, the vial may be rotated end to end gently, but it should never be shaken with sufficient force to produce froth or foam within the bottle

Globin Zinc Insulin This contains a protein obtained from erythrocytes It is a clear solution, and its action reaches a peak in eight hours Thus, it is of shorter duration than is the turbid protamine zinc insulin The initial action of globin zinc is somewhat more rapid than that

of protamine zinc insulin but by virtue of this fact, the long duration action is sacrificed Therefore, there is not the desirable action beyond twenty four hours Globin insulin, by its initial rapidity of action, was expected to eliminate the patient's need for taking two doses of insulin before breakfast since the initial rapid action was expected to supplant the rapid action of crystalline Actually, this desired action does not occur, for unless the carbohydrate of breakfast is reduced to one fifth of the day's allowance, the postbreakfast blood sugar rises excessively This seems to indicate that the initial release of globin zinc insulin is slower than that of crystalline, and too slow to provide for nornal breakfast needs The policy of reducing breakfast is not always a wise one Insulin should be subordinate to diet, and in most instances it would be wiser to plan for an adequate breakfast with two injections of insulin, if necessary, rather than to reduce the breakfast to substandard levels merely to reduce the insulin requirement to one dose Unless a new preparation of insulin offers advantages which make it more desirable than the original type, its appearance on the market only adds a confusing element

IN PATIENT VERSUS OUT PATIENT REGULATION

Insulin regulation during a hospitalized period offers one significant advantage, comprehensive education, which outweighs any disadvantage The very fact that he is being hospitalized impresses the patient with the seriousness of his condition During hospitalization he usually sees not only the good results of treatment but patients whose carelessness caused the development of complications such as gangrene and diabetic coma Such cases act as an edifying influence on the new diabetic, for unless he actually sees for himself the unfortunate

results of carelessness, it is difficult for him to appreciate his own nearness to them

Until recently, only patients with mild diabetes were regulated as out-patients and those who had severe diabetes entered the hospital Recently, the trend has been to regulate and educate the diabetic patient while he is busy with his usual activities Under this plan, hospitalization is reserved for acutely ill diabetics, and those who are experiencing medical or surgical complications There are many favorable points which may be stressed for both in-patient and out-patient regulation The out patient plan is less expensive for the immediate situation, and it enables the patient to become regulated under his normal circumstances The personnel of the out-patient clinic, however, must be well trained and well guided so that the patient will be systematically taught all of the salient facts concerning his disease At present, diabetes is a life-long proposition, and although longevity is expected, freedom from complications is still a relatively unachieved goal However, if the clinic teaching program is individualized according to the patient's needs, and a good follow-up system established, the out-patient method of regulation and instruction is ideal

RATIONALE OF INSULIN PRESCRIPTION

The physician usually orders a small dose of protamine zinc insulin, approximately 20 units, at the first visit, after diagnosis has been established If the patient is young, 30 units may be ordered, if the patient is elderly, 10 to 16 units The initial dose is not changed for three to five days since protamine zinc insulin takes this long to accumulate At the end of this period, the patient's urinalysis chart is studied If the fractional tests, which he has been doing himself at home, are in the negative-

to green range but the twenty four hour specimen contains about 20 grams of sugar, the protamine insulin may be increased by a few units However, if the single urine test before breakfast is negative, but the one voided at noon shows a yellow reaction, the physician might not order the dose of protamine insulin altered in any way, but he might add a small dose of crystalline insulin to be taken before breakfast in addition to the protamine zinc The protamine zinc insulin requirement is largely determined by the amount of sugar found in the second urine sample voided before breakfast The need for crystalline insulin is largely determined by the sugar content of the urine passed four hours after breakfast

The rationale for these two statements is simple if the nurse will recall the difference in the actions of protamine and crystalline insulin Protamine zinc insulin is not expected to act effectively for the first few hours following injection, but it should carry over for more than twenty-four hours As has been stated, the protamine zinc insulin taken at 7 00 A M on one day becomes appreciably effective by noon of the same day, and then continues to work effectively until noon of the following day, but with a tapering action in the last few hours Thus, if the test before breakfast shows sugar, the protamine insulin should be increased slowly to that dose which produces a normal blood sugar, or a urine test which is negative for sugar, before breakfast on the following day However, if the tests before breakfast are satisfactory, but the test before lunch shows a high percentage of sugar, this finding reveals a need, not for more protamine, but for a complementary dose of crystalline insulin before breakfast The rapid acting insulin would prevent the postprandial loss of sugar in the urine by bridging the gap of diminishing activity of the protamine insulin

ADMINISTRATION OF INSULIN

Insulin is injected subcutaneously Sometimes insulin is given intravenously, but when it is given this way, a large percentage of the dose is lost in the urine Insulin is not given intravenously unless the patient is in extremis from circulatory failure, at such times, a matching dose is usually given subcutaneously so that, should the circulation improve, the insulin in the subcutaneous site will become effective to replace that portion which has been excreted by the kidneys

When the patient requires two types of insulin before breakfast, these are given as two separate injections However, some physicians teach their patients to mix the crystalline and protamine insulins in one syringe McBryde and Roberts state that if the insulins are mixed in equal portions, and the *p*H of the mixture adjusted to 7 2, the resulting combination will be one-third crystalline and two-thirds protamine insulin This combination could not be mixed by the patient at home because of the difficulty in stabilizing the *p*H at 7 2 If the *p*H is not adjusted, the substance injected will be more acid than is the tissue fluid, and this would cause further variation in the rate of absorption There is actually an excess of protamine in protamine insulin so that when the crystalline insulin is mixed with it, part of the crystalline is taken up in suspension Usually, the patient finds it easier to regulate his diabetes by administering two hypodermic injections before breakfast, for the determination of a satisfactory ratio and a correct *p*H is too complicated and time-consuming for the average patient

Insulin is quite ineffective when it is given by mouth because of digestive action on protein Insulin has been given by inunction, vaginally, rectally, intranasally, and intraocularly When administered by these various

routes, insulin is effective, but the varying rate and degree of actual absorption makes these modes of introduction highly impracticable

THE MEASURING OF INSULIN

Since each vial of insulin has a label which states the exact number of units found in 1 cc of a given strength, a syringe which is divided into fractions of 1 cc is the writer's preference Insulin syringes which are calibrated for specific strengths of insulin are also available

VARIOUS CONCENTRATIONS OF INSULIN

Insulin is sold in several concentrations or strengths, but in each strength a unit retains the same identity Table 2 gives the concentrations

TABLE 2

UNIT VALUE OF VARIOUS CONCENTRATIONS OF INSULIN

STRENGTH	COLOR OF VIAL TOP	UNITS PER CC	UNITS in 0 1 CC	NO CC GIVING 20 UNITS
U 10	Blue	10	1	2 0
U 20	Yellow	20	2	1 0
U 40	Red	40	4	0 5
U 80	Green	80	8	0 25
U 100	Brown	100	10	0 2

The formula or rule for measuring insulin would be as follows

$$\frac{\textit{Dose desired}}{\textit{Number of units in 0 1 cc}} = \textit{number of tenths of a cc of any given strength}$$

Example

Using U-40 protamine zinc insulin, measure 32 units The fraction would be $^{32}/_{4}$ equals 8 or 0 8 cc.

If the concentration on hand were U-80, the fraction would be $^{32}/_8 = 4$, or 0 4 cc

The nurse usually decides which concentration of insulin to use Regular insulin comes in all strengths, crystalline, globin, and protamine are prepared only in the U-40 and U 80 strengths

SIZE OF HYPODERMIC NEEDLE

A 26 gauge needle which is ½ inch long is best when insulin is injected at a 45 degree angle to the skin A shorter needle does not deposit the insulin deeply enough, and it would therefore cause discomfort at the site of the injection The fineness of a 27 gauge makes it too flexible for most patients to use without the possibility of breakage

SITES FOR INJECTION

The ideal sites for injection of insulin are the outer aspect of the upper arm, the front or outer aspect of the thigh, or the upper outer quadrant of the buttock Occasionally, in male patients, the skin at these sites is difficult to penetrate whereas the skin over the abdomen is usually satisfactory A needle which is ⅜ inch in length would be preferable to one which is ½ inch in length when the abdominal wall is used

LOCAL LESIONS FOLLOWING INJECTIONS

ALLERGY

The most common local lesion to result from the injection of insulin appears within the first few days after the initial dose as an urticarial lesion with characteristic redness, swelling, and itching When one con siders the origin of this exogenous insulin which may contain proteins, from both cattle and fish, one is surprised not to see the urticarial reaction more frequently Ap-

proximately 50 per cent of all diabetic patients experience this localized manifestation of sensitivity at the onset of treatment with insulin, and these allergic signs may be present for as long a period as four to six weeks If the patient does not overcome the sensitivity at the end of two months, he is usually helped by changing to a different trade-brand preparation of insulin The improvement occurs, not because one brand is superior to another, but because one commercial house may prepare insulin from hog pancreas, to which the patient may be more allergic, and the second preparation may be obtained from beef pancreas to which the patient is less allergic Cold compresses with witch hazel are soothing to the skin, but the condition is not one which is severe enough to warrant the omission of insulin This localized lesion is not to be confused with a generalized allergic reaction which is rarely seen, but which demands careful evaluation Desensitization can always be accomplished by starting these patients on dilute solutions of insulin, 1 to 1,000-000 000 if necessary, and then very gradually concentrating the insulin as the patient's tolerance improves Patients who have generalized allergic reaction must be instructed never to omit insulin even when the diabetes is insignificant, for should the mild, insulin sensitive diabetic develop an overwhelming infection, or should he require emergency surgery, his inability to tolerate a required supplement of exogenous insulin may present a grave problem

TUMEFACTIONS

Another type of topical lesion which is seen too frequently in patients who have been taking insulin for a long time, is the so-called tumefaction, it appears as a

hard, painless lump which may be composed of lipoid or fibroid tissue Tumefactions may be prevented if the insulin is injected into scattered areas, and not given repeatedly at the same spot Because these tumefactions are devoid of sensation, the diabetic is tempted to use them consistently Insulin should not be injected into such masses because absorption from these regions is unreliable The hardened tissue masses are not sound, but lend themselves readily to abscess formation The nurse should always examine and study the area into which she injects insulin to be certain that she is using a satisfactory site A diabetic who has been taking insulin for some time may object bitterly to a rotation scheme, but such a situation is another challenge to the nurse's teaching skill

LIPODYSTROPHY

A third type of localized skin lesion is known as lipodystrophy This lesion appears as a hollowed or sunken area in the skin The depressions represent a partial or complete disappearance of the subcutaneous fat Lipodystrophy is never seen in adult males, but only in young boys and females in all age groups This lesion is painless, does not involve muscle, and does not impair the function of the part Many physicians allow their patients to continue using the atrophied areas for insulin injections, but usually the patient is advised to avoid them Although lipodystrophy is benign, it is disfiguring, particularly when sport clothes or short sleeved dresses are worn If the use of the depressed area is entirely avoided, the lesion usually fills in, partially or fully, within a year or two, but not always Patients with lipodystrophy are advised to use the U-80 strength insulin even when the dose prescribed is small The type of insulin used, whether regular, crys-

tallıne, or protamıne, seems to *have* no *bearıng* on the ıncıdence of these atrophıed areas

Concernıng the few and unavoıdable localızed lesıons whıch occur as the result of usıng ınsulın, Dr Joslın has aptly saıd that the benefits derıved by dıabetıc patıents from the use of ınsulın far outweıgh the mınor dıscomforts experıenced

INSULIN RESISTANCE

Insulın resıstance ıs frequently a mısnomer because the term ıs often applıed to the dıabetıc whose dıabetes ıs controlled on a dose of 100 unıts of ınsulın daıly Such a maıntenance dose ıs commonly requıred ın young dıabetıcs who may need even more than 100 unıts daıly While doses of thıs sıze are not unusual durıng adolescence and youth, a 100 unıt ınsulın requırement would be of sıgnıficance ın patıents over fifty years of age, even then, such a dose could hardly be used to desıgnate ınsulın resıstance Accordıng to most authorıtıes, the patıent should not be termed ınsulın resıstant unless he requıres more than 400 or 500 unıts of ınsulın daıly for a long perıod of tıme, the need for thıs requırement should be establıshed durıng adequate supervısıon whıch means at least hospıtalızed observatıon There are many loopholes for the patıent outsıde of the hospıtal For ınstance, the patıent may be usıng honey as a sweetenıng agent *because he thınks honey ıs a "natural sugar"*, or he may be ınnocently drınkıng large quantıtıes of mılk because he thınks ıt ıs ' good for hım", or hıs dıet may be eıther excessıvely hıgh or ınconstant ın the amount of carbohydrate, or both Nor ıs the dıabetıc ınvulnerable to abnormal behavıor patterns, and so the dıagnosıs of absolute ınsulın resıstance ıs applıed most cautıously In realıty, true ınsulın resıstance ıs rare, and hormonal

antagonism is believed to be the chief cause of the condition Relative insulin resistance, however, is seen frequently, especially in the presence of infection

INSULIN REACTION

PHYSIOLOGY

When the blood sugar level becomes abnormally low, manifestations of insulin reaction, or hypoglycemia, occur Authorities disagree on the exact diagnostic level, and this is understandable, for the characteristics of hypoglycemia are protein The symptoms vary from patient to patient, and similar symptoms are present at varying levels of blood sugar The signs and symptoms of insulin reaction usually occur when the blood sugar content is at 70 milligrams per 100 cc of blood Symptoms may occur at a higher level in one individual, and symptoms may be completely absent in another individ ual whose blood sugar is much lower than 70 milligrams Patients who develop symptoms at higher levels are usually the ones who have been maintained for long periods of time at blood sugar levels which are supernormal These patients do feel miserable and they do experience hypoglycemic symptoms when the blood sugar is lowered to such conservative levels as 120 or 140 milligrams Patients also develop symptoms of hypoglycemia when the blood sugar decreases rapidly from a high level to the upper limits of a normal level

ETIOLOGY AND PREVENTION

Except for extreme instances, the insulin-treated diabetic develops insulin reaction because of imbalance between food and insulin There is a surplus of available insulin, and a dearth of available carbohydrate for the particular moment or event, or an excessive amount of

insulin may be present because of improvement in the diabetic status

IMPROVEMENT

Improvement may be interpreted as meaning that the diabetic is producing more units of endogenous insulin than he was producing previously This means the units of exogenous insulin should be reduced in number since exogenous insulin is complementary The prevention of insulin reaction of this type is best accomplished by routine evaluation of blood sugar levels A urine test which is negative for sugar, in the absence of hypoglycemic symptoms, is not conclusive evidence that the insulin dose should be reduced, for the blood sugar may be higher than 170 milligrams in the fasting state without the presence of sugar in the urine

ERROR IN MEASUREMENT

An error in the measuring of insulin may provide the diabetic with a temporary excess The patient may ordinarily use U-40 insulin, but he may have inadvertently purchased a vial of the U-80 strength, and measured out the same amount and thus have given himself a double dose He may break his only insulin syringe, and a differently calibrated new syringe may cause confusion He may take his insulin in an upstairs bedroom, but his reading glasses may be in a downstairs living room, and he may then estimate the amount inaccurately In the confusion of dressing, breakfasting, and hurrying to work, he may unwittingly take his insulin twice

FOOD SHORTAGES

A temporary shortage of food could result from several factors Sometimes, the patient does not eat his complete diet, not because of loss of appetite, but because of in-

sufficient time If the nurse will put herself in the patient's position, this becomes more obvious When the average individual is late in rising because he went back to sleep after quieting the alarm clock, he would hardly tell his employer that he was late because the process of cooking and eating breakfast took so much time The diabetic, who is also an heir to human frailty, might try to omit his breakfast partially or fully under these circumstances The nondiabetic, as the result of his breakfast omission, may develop a headache and a disposition which is a trial for his fellow-workers, the diabetic, however, will usually come to grief

Postponement of a meal may produce an insulin reaction because it produces a temporary shortage of food Ordinarily, the patient may safely delay his meals to within an hour of the customary time, but the fact must be realized that such delays produce relative food shortages while the insulin is released slowly but constantly The diabetic must be instructed carefully concerning this factor for it involves his personal life and his business life If the patient's occupation produces irregularity of eating hours, he must be fortified with between-meal snacks One rarely advises the patient to change his occupation Rather, one instructs him to adjust his diabetes to his work If the patient does executive or administrative work, he must avoid hypoglycemia with its central nervous system manifestations Conferences and meetings which last beyond the usual eating hour should be anticipated by the patient Otherwise, in a tense moment, he cannot be sure whether his nervousness is caused by the issue under consideration, or by a beginning hypoglycemia Therefore, he should never be without available carbohydrate Delay in eating frequently causes reactions on Sunday or holiday mornings

when many people delay their breakfasts by two to five hours in order to enjoy the luxury of extra sleep One does not like to deny the diabetic person this privilege, but such a program should not be attempted without careful planning Logically, those patients who require the larger doses of protamine zinc insulin must plan most carefully There are several plans which the individual may formulate for his own particular circumstances, and it is apparent that all patients do not have sufficient acumen to do this planning The following schedule is safe, but time-consuming to explain

First, the nurse should calculate the approximate amount of carbohydrate, protein and fat in the breakfast of the patient's diet About half the total is converted into food in terms of bread (or crackers) and cheese, peanut butter, or meat This meal is taken with the usual bedtime lunch on Saturday night Should the diabetic person sleep until about 10 00 A M, he may then have the other half of the breakfast allowance Should he plan to sleep until noon, there should be a glass of orange juice at his bedside which he should drink in the event he awakens during the morning, or certainly before he gets out of bed Some patients would not be able to go without food until noon, and they have the alternative of setting the alarm clock or having a member of the family rouse them at a set hour for the orange juice

Fasting, accompanied by exercise, even when the exercise is moderate, is hazardous Catholic patients who plan to go to church fasting, therefore, must be instructed to attend church at an hour which is early enough to enable them to eat breakfast by 9 00 A M

Those patients who live in rooming houses where breakfast is not served, must be instructed to eat a portion of rapidly assimilable carbohydrate such as fruit,

before leaving their houses to go to a restaurant for breakfast

Unusual exercise causes a temporary shortage of food It is not the degree of vigor of the exercise which counts, but the unusual quality of it If a diabetic boy were to go out for football practice every night, that exercise would be strenuous but not unusual Therefore, in all probability, he would not have a reaction If he were to go bowling one night a week, that would be unusual exercise for him, and would therefore require extra food All types of exercise are permissible, but some are more hazardous than are others Riding and swimming should follow meals rather than precede them For instance, if dinner is at 1 00 P M , it would be wiser for the diabetic to go swimming at 3 00 P M rather than at 5 00 P M If the diabetic takes both crystalline and protamine zinc insulin, swimming in the morning may be dangerous Physical activity is excellent if it is correctly timed, and not carried to the point of fatigue Exercise is stressed so much in the treatment of diabetes that the nurse should warn elderly patients not to attend gymnasia or take part in other physical activities to which they have never been accustomed

Some people develop temporary food shortages because they use many calories in nervous behavior which is motivated by good or bad news, or the anticipation of either Their behavior consists of activity which is both rapid and purposeless The anticipation of a trip to the dentist, for instance, may use up so many calories that when the patient arrives for his appointment he is on the verge of a reaction which further aggravates his nervous behavior and thus makes him a difficult patient for the dentist The nurse will not find it too difficult to determine which patients will need particular instruction to avoid insulin reactions in moments of great emotional stress

SYMPTOMS

When the blood sugar drops to a level below 80 milligrams, the patient may experience symptoms such as extreme hunger, headache, weakness, excessive perspiration or vomiting He may appear irritated, excited, or exhausted to the degree of faintness, but his pulse is usually strong and full If the hypoglycemia is not recognized and treated in the early stages, the patient may develop double or blurred vision grimacing, loud talking, or boisterous laughing or crying of compulsive nature The patient, though still conscious, may have epileptiform twitchings which involve half or all of the body He may exhibit many personality changes, the outstanding one being that of marked negativism Some patients have speech disturbances which make them unable to formulate words although they understand all that is said to them

If treatment is not received, the patient may lose consciousness suddenly If the physician is called to see an unconscious diabetic patient in the patient's home, the problem of diagnosis may be extremely difficult The patient could be in profound reaction, but he may have had a cerebral accident or some other condition of which unconsciousness is pathognomonic Insulin reaction is rarely fatal unless the diagnosis is missed, and the hypoglycemia completely untreated during the comatose phase Until the last decade or so, an unconscious diabetic was frequently diagnosed as having diabetic coma, so that it is not surprising that most fatalities from reaction occur in those patients who are mistakenly treated for diabetic coma The unconsciousness of hypoglycemia is believed to be the result of cerebral edema, and lack of sufficient carbohydrate to permit normal metabolism in the brain This may produce permanent brain damage if hypoglycemia is prolonged

TREATMENT

In the early stages of insulin reaction, treatment is simple and effective By far most reactions are discovered and treated in the early stage by the patient himself Sugar in a quickly assimilable form works immediately If the patient is at home, he may take a portion of fruit, fruit juice, honey, syrup, jam, or sugar in a liquid such as coffee If he is downtown, a glass of ginger ale or any flavored carbonated drink is quickly obtainable and immediately effective Carbohydrate in some form, however, should always be carried by the patient Lump sugar is not always available, but the nurse should teach the patient to carry a roll of candy "life savers" in the pocket of each suit, or in each pocketbook To further protect himself, the patient should also be instructed to carry always an identification card which states his name and address, explains that he is a diabetic, and gives information concerning his daily insulin dose, his diet prescription in figures, and his physician's name and telephone number This information is essential because the patient may become involved in an accident which produces brain trauma with unconsciousness Because his diabetes might not then be recognized, he might slip into the state of hypoglycemia and thus add to the confusion of the whole picture

Symptoms of reaction develop more strangely in the younger diabetics who do not always recognize their own symptoms since they frequently appear as personality changes The nurse must understand the full meaning of the term negativism in her contact with younger diabetics One does not ask, "Are you having a reaction?" or "Would you like a glass of ginger ale?" because the answer will nearly always be a negative one Later, when he has recovered, the patient will remark that he knew

he was having a reaction or that he know he needed carbohydrate, but that he could not make himself admit it The easiset way to overcome this phase of negativism is simply to hand the patient a container of ginger ale or orange juice, and he will drink it automatically in most instances If he is having Jacksonian twitchings, he may need help in holding the cup to his lips A thin glass tumbler is dangerous for it could easily be cracked between the teeth during a convulsive motion Often, the patient remembers nothing of the episode, sometimes he can recall with assistance, and sometimes he remembers the entire incident Such types of reaction are usually more distressing to the patient than those reactions which bring unconsciousness

If the physician is called to treat an unconscious diabetic in the patient s home, he usually obtains a sample of venous blood which will be analyzed later for sugar content Then, with the needle in the same site, he injects about 20 cc of 50 per cent glucose If the patient has uncomplicated hypoglycemia, he usually responds before he has received the 10 grams of glucose contained in the solution If the patient does not respond after receiving this treatment, immediate hospitalization is usually indicated If, for instance, the patient has had a cerebral accident, the administration of glucose will not enable him to regain consciousness A urine specimen, which could be obtained by catheterization, would be of little value since the urine obtained might have been in the patient's baldder for hours, and it might have been formed when the blood sugar was elevated Therefore, if the urine were tested and found to be strongly positive for sugar, insulin reaction still could not be ruled out

Glucose apparently is not absorbed rapidly enough when it is administered rectally, for such treatment is

ineffective Glucose solution is effective, however, when it is administered through a stomach tube, but the intravenous route is simpler, and more rapidly effective

PROGNOSIS

The prognosis is good if the condition is diagnosed, and the correct treatment given reasonably promptly The rare fatalities or irreversible changes which are seen following hypoglycemia are more often the result of incorrect diagnosis rather than delay of treatment Given time, the patient who falls into stupor from hypoglycemia may recover without treatment of any kind, whereas if the condition were incorrectly diagnosed as diabetic coma and treated as such, even with relatively small doses of insulin, the changes involving the central nervous system might become irreversible even should the patient make a chemical recovery, i e, the blood sugar return to normal levels

TEACHING THE DIABETIC PATIENT

OVERCOMING THE PATIENT'S OBJECTIONS

Insulin therapy is the angle of treatment to which most newly diagnosed diabetics object They will offer to live stoically on starvation diets no sacrifice will be too great if only insulin can be avoided The knowledge of one unfortunate experience involving the use of insulin by a friend who has been careless far outweighs the experience of ninety-nine other people with diabetes who are capably carrying on and assuming their responsibilities to society

The teaching nurse should approach her patient with a sympathetic but positive attitude To overcome his objection, the nurse herself must not only be convinced of what insulin can do for the patient, but she must also

tion, the nurse might explain another natural defense mechanism with which the patient is more familiar For instance, if a splinter is not removed, then it "festers" its way out Nature, with a similar motive, makes the untreated diabetic thirsty to help in the elimination of the extra sugar which cannot be utilized when insulin is absent In a diluted form, this incompletely digested food is *eliminated as sugar in the urine* Thus, the untreated diabetic loses so much food value as sugar voided in the urine that he receives little benefit from the food which he eats Therefore, he is constantly hungry despite the increased portions of food which he is eating The presence of frequency of urination requires little explanation to the patient since he realizes that it follows polydipsia When the vicious cycle is explained to him, the patient will readily understand his own loss of weight and strength

The Continuous Need for Insulin Therapy After this careful explanation, the teaching nurse should not be discouraged if the patient, who sometimes feels cornered when he realizes the truth about insulin, asks, "But if I start insulin, will I have to take it forever?" The answering of this question demands the utmost tact, perhaps more than any other which the patient may ask The nurse must know her patient, must recognize the limits of his education and personality before she answers In fact, from the beginning of the teaching period, the nurse should have been preparing her answer to this question, *for any hesitation on her part in answering the question* may cause some patients to lose confidence in the nurse's answer even when it is truthful

In the first place, nobody can yet answer this particular question with surety, but the nurse can draw on her own information concerning the historical background of

diabetes to show that although the disease itself is ancient, its progress in treatment is relatively new, but constant The nurse should substantiate her statement by bringing out the fact that diabetes was described before the time of Christ, but that insulin was not discovered until 1921, that from 1921 to 1935, it was necessary to inject insulin before each meal and often again at bedtime, that since 1935, the diabetic takes his insulin only before breakfast, and yet his disease is better controlled than it was formerly on multiple doses The nurse should tell him about alloxan and of the other work which is being done in the research centers throughout the world In all truth, insulin may not be used "tomorrow " It may be replaced by a new treatment, for medical progress is constant Another point for the nurse to stress at this time is that the patient should never omit his insulin, or substitute a commercial product for it without his doctor s consent If the nurse herself has the right philosophy concerning insulin, her patient will usually accept it

It is a recognized fact that intelligent adults are not always emotionally mature, and while a patient may accept in thought his need for insulin, he may still insist, "I would rather die than take that needle every day " Sometimes patients who talk like this really mean what they say, but usually they do not Their attitude requires patience and acumen on the part of the teacher The patient's life often does depend on his taking insulin, and so the nurse is professionally obligated to leave no stone unturned in her efforts to convince the patient of his need If the patient has a family or dependents, the nurse can often win her point by enlisting the aid of the family, reminding the patient that his family needs him because they love him, enjoy his company, depend on him to "talk things over " This approach is quite effective

even when the patient is elderly or feeble if the nurse finds a member of the family as an ally

There will be many other problems experienced in convincing the diabetic patient to take insulin When the real motive for refusing insulin seems to be a fear of hypodermic injections, the nurse will find the results satisfying if she "takes the patient by surprise" and has him inject the dose which she has already prepared, even though he has not had a lesson in the technique of hypodermic administration While the patient holds the syringe, the nurse holds his hand, guiding it to give the initial "push" which causes the needle to penetrate the skin The patient feels that he has done it himself, and for the first time admits that he "might do it with practice" This procedure reverses the program of explanation followed by demonstration, but it is dramatically effective and time-saving

Why Insulin Must Be Administered as a Hypodermic It is important to tell the patient why insulin cannot be taken by mouth Avoiding medical terminology, the nurse should explain that insulin is a protein, and that the digestive processes would utilize it like meat with a resulting loss of the specific action of the insulin as a hormone

TEACHING THE PATIENT HOW TO MEASURE AND ADMINISTER INSULIN

Types of Insulin Syringe The Joslin syringe seems most practicable It has just one graduated scale which is divided into tenths of 1 cc, and thus it eliminates much of the confusion which comes from the use of a syringe having two or more scales based on the different concentrations of insulin The Joslin syringe is about twice as long as the average insulin syringe, and the longer span

with 10 large divisions, makes the scale more adaptable to the vision changes which are so commonly seen in diabetics

Many patients can be taught how to measure their insulin in cubic centimeters, but for the large number who cannot, there is a simpler, though perhaps less ideal, method First, if the patient takes more than 40 units of insulin at a time, he should be instructed to use the U-80 concentration Except for the unusual instances mentioned in the section on local skin lesions resulting from the injection of insulin, the U-40 concentration will do for all doses of less than 40 units The nurse should explain to the patient that when the syringe is filled with U-40 insulin, it holds exactly 40 units, and that each tenth, or space, holds 4 units Thus, if the patient is to take 28 units, the nurse will draw the plunger of the syringe down, adding aloud by four at each line designating one tenth, until the 7 mark is reached Then, she will assign other doses to the patient, and ask him to do the calculations aloud She might draw a sketch of the insulin syringe in his notebook in the following way

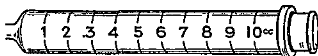


Fig 7 Insulin syringe

One syringe (1 cc) contains 40 units
One space (1 or 1/10) contains 4 units
One-half a space contains 2 units
Thus, 7 spaces (7) equals 28 units
And 7 1/2 spaces contain 30 units.

Should the patient report to the clinic by telephone, there will be no question about his dose, even when the

patient himself is confused about which concentration he *is using If a 1 cc syringe is used, the patient is asked* first how many spaces he is taking, then he is asked the color of the insulin vial top If he says that he is taking *8 spaces from a vial with a red top, he is using U 40* insulin (see p 69) His dose would immediately be recognized as 32 units (8 × 4 equals 32) If he says the top is *of green color, he is using U-80 insulin and the dose* would be 64 units (8 × 8 equals 64)

The nurse should stress the need for a "spare" syringe *Otherwise, if the patient has but one syringe, it may get* broken on a working day before he has injected his insulin He may then have to wait an hour or two before the local druggist opens his store Some states require a physician's prescription before each purchase of hypodermic equipment This would mean a further delay while the patient located his doctor Sometimes, under these circumstances, the patient omits his insulin, unwittingly jeopardizing his life rather than lose time from work which might jeopardize merely his job or his finances In order that such vital decisions do not rest on the inexperienced patient, the nurse must impress him with the absolute need of double equipment

The writer is opposed to the use of short syringes which are calibrated to accommodate two or more different concentrations of insulin The very shortness of the syringe and the fineness of the calibrations tax the poor vision of elderly patients On these short syringes, each unit of insulin is given one space on the scale, thus, when U 80 strength is used, there are 80 calibrations cramped into a space which is only 1¼ inches long The spacings are so fine that they constitute a problem for most patients who are fifty years of age or older because many people in this age group are far sighted Frequently, patients

are admitted to the hospital who make statements to the effect that they are taking 40 units of U 80 insulin After a long time spent in questioning, one learns that the patient was taking 80 units because he was using a U-80 vial of insulin and the U-40 side of a syringe, and withdrawing insulin to the 40-unit mark, or a patient may say that he is taking 80 units of U-40 strength whereas he is actually taking 40 units because he is using a vial of U-40 insulin and the U-80 side of a syringe, drawing down to the 80-unit mark

Self-administration A lemon or an orange serves well as a medium for the acquisition of skill in hypodermic administration All directions concerning the procedure should be available on a mimeographed sheet which may be pasted in the patient's notebook However, since the printed page does not replace actual teaching, the nurse should carefully demonstrate each step without referring to the printed page. Then, the patient should repeat the procedure to assure the nurse that he can proceed at home without assistance Then, he is given the printed page merely as a reference for future use The following instructions are used by the patients at the George F Baker Clinic of the New England Deaconess Hospital

I Sterilization of Equipment

1 Place the separated barrel and the plunger (the two glass parts of the syringe), and a 4 to 6 ounce bottle with a narrow neck on a clean cloth in the bottom of a pan Cover completely with cold water, heat to boiling, and allow to boil for five minutes Pour off the water, being careful not to touch anything in the pan, and allow to cool by standing

2 Wash the hands thoroughly with soap and water Then place the empty bottle on the table, and fill with 70 per cent alcohol

3 Pick up the barrel of the syringe with the fingers Then, pick up the plunger by knob like part on one end, and insert into the barrel Pick up the needle by the butt and place on the syringe, pressing down hard and turning a little to the left or to the right to insure tightness Then, place syringe with needle attached into the bottle of alcohol The entire equipment should be sterilized by boiling every two weeks, and fresh alcohol placed in the bottle (Fig 8)

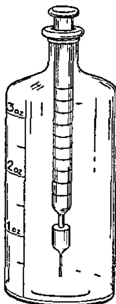


Fig 8 Syringe in alcohol bottle

II Daily Administration

1 Wash hands thoroughly with soap and water
2 Remove syringe from alcohol filled bottle Expel all of the alcohol by rapidly pulling the plunger back and forth
3 If protamine insulin is used, mix gently as demon strated but do not shake the bottle Wipe the top of the bottle with alcohol

4 Push the needle cautiously but firmly through the indentation of the rubber cap, invert the bottle, and then withdraw the desired amount of insulin If an air bubble is present, expel the insulin back into the bottle, and slowly again withdraw the desired amount

III Injection

1 Use the right leg one day, and the left leg the next day Use the area above the knee, on the outer aspect of the thigh It is necessary to change the site with each injection

2 Having decided on the site of injection, wipe with alcohol a space the size of a half dollar

3 Pick up a fold of the skin with the thumb and fore-finger of the left hand Hold the syringe like a pencil and at a 45 degree angle to the skin Push the needle firmly into the fold almost up to the butt Then, release the fold and steady the needle with the left hand Inject the insulin by pressing the plunger with the thumb of the right hand Cover the area with a pledget of absorbent cotton which is wet with alcohol, and quickly withdraw the needle

Note If the insulin has been given too close to the skin, a white blister like elevation will appear

A red itchy area may occur following each injection during the first two to six weeks

IV Cleaning Up

1 Rinse the syringe and needle in the alcohol by drawing the alcohol up into the barrel at least twice Leave the equipment in alcohol until the next administration of insulin

The patient usually requires much practice, under supervision, in drawing the insulin from the vial and in handling the equipment The average patient is quite courageous about administering his first hypodermic, but the nurse can contribute to the success of the occasion in questionable instances When the practice demonstration has been finished, the nurse should assume a pose of certainty She should not ask the patient if he

would *like* to take his own insulin, for such a question introduces an element of doubt It will be wise to discourage the patient's suggestion, should he make it, of further practice with a lemon at home The expression of a desire "to practice" is usually motivated, in this instance, by a feeling of inadequacy and fear Once the patient has actually injected his own insulin, he is surprised at the simplicity of the procedure, the relative lack of pain, and he is greatly impressed with his own skill

*EXPENSE OF TREATMENT**

Insulin comes in vials containing 10 cc and the cost per vial is less than $1 for 400 units Therefore, if the patient requires 40 units daily, insulin would cost him *approximately $3 a month, and the combined cost of* absorbent cotton, alcohol, and needles would total about 75 cents more For a year, this would mean a total cost of about $45 The diabetes of many patients is controlled on 10 to 20 units daily, or at an annual cost of $20 to $30 The cost of insulin therapy may be a burden, not to the really underprivileged person who receives aid, but to those persons who are just able to maintain themselves without benefit of organized help In adolescence and youth, before economic independence has been achieved, and when diabetes is at its severest phase, the daily dose required is often 80 to 100 units Fortunately, the majority of diabetics are in the age group which requires less than 40 units of insulin daily Strangely enough, one rarely hears diabetics complain of the cost of therapy, and still more rarely, of a diabetic omitting

*Temporary market conditions may influence price of insulin Shortly before this book went to press the cost of all insulin was increased 50 per cent Indications are however, that prices will drop sharply in the near future.

his insulin because of the expense Perhaps behind this lack of complaint is a realization that without insulin he would be unable to work or to care for himself

Patient's Purchase of Insulin Equipment The purchase of insulin may offer many problems because there are five concentrations and four types on the market Patients must be warned that they cannot substitute globin for protamine solution They are told sometimes that globin is the newest insulin, and therefore the best Protamine and globin insulins are not identical in their actions, and they should not be interchanged without individual instructions from a physician

The patient should be instructed to examine the protamine insulin container for the expiration date The expiration date on regular and crystalline insulins is not so important since these insulins are quite stable, they may be frozen or boiled without appreciable change However, if the precipitate in the vial of protamine insulin clumps or sticks to the side of the bottle after rotating gently, the insulin should not be used

The nurse should warn her patient not to use the so-called insulin substitutes Relatives and friends often deluge the patient with literature and advertisements concerning food and herbal "cures" The newly diagnosed diabetic is most frequently the gullible one because months pass sometimes before he accepts his disease and its limitations The veteran diabetic does not usually consider insulin to be so much of a problem even as diet, and he is far less credulous than is the patient who is starting treatment

Most clinics prefer to sell equipment like insulin syringes and needles directly to the patient, but often it is the nurse's responsibility to instruct the patient concerning his purchase of essential equipment at a local

drug store A shopping list with a minimum of supplies to serve his purpose might contain the following

1 insulin syringe (1 cc divided in tenths)
2 hypodermic needles, 26 gauge, 1/2 inch
1 pint of isopropyl alcohol--70 per cent
1 package of absorbent cotton
1 crystalline insulin, U-40
1 protamine zinc insulin, U-40

DISCUSSION OF INSULIN REACTION WITH THE PATIENT

Insulin reactions must be prevented Ninety-nine patients living in a community may live normal lives because of insulin, but the hundredth one who develops a severe reaction, perhaps because of carelessness, may cause inestimable prejudice toward insulin Employers may show their understandable prejudice by refusing to hire diabetics who take insulin, and hundreds of diabetic patients will manifest their prejudice by refusing to take insulin Education of the patient is the answer to the problem concerning insulin reaction Diabetes is no respecter of maturity, immaturity, folly, or wisdom people with various personalities and varying degrees of intelligence develop diabetes and require insulin Instructing such a cross-section of society offers another challenge to the teaching nurse

Many, perhaps most, diabetics go through life without ever experiencing an insulin reaction It is fortunate that older patients usually require smaller doses of insulin for they are less self-confident, and have a greater amount of cerebral arteriosclerosis For the patients who require approximately 10 to 20 units daily, the nurse will show greater wisdom if she spends little time on the dangers of insulin reaction, but rather concentrates her teaching toward stressing a need for regularity in diet, urinalysis, and scheduled visits to the clinic or doctor Protamine

insulin is slow acting, and 20 units spread over twenty-four hours means there would hardly be enough insulin liberated at any one time to produce hypoglycemia unless the patient actually omitted a meal

One does not necessarily advise the patient to change his occupation even though his insulin requirement is large Instead, because each diabetic differs from his fellow-diabetics in age, education, intelligence, and occupation, the nurse must plan to teach the patient how to adjust his diabetes to his normal life There would be no challenge to the nurse s teaching skill if she planned a reversal of the patient's normal life to accommodate his diabetes

Thus, if the patient is a bus driver, the nurse would impress him with a need to recognize and interpret the symptoms of hypoglycemia, as well as how to prevent the condition She should teach him the absolute need of having small carbohydrate snacks every two hours while he is driving A small apple, a portion of any fruit which is easy to carry, or a glass of milk should the patient desire it, is adequate Only those patients who are intelligent, well trained, and conscientious should be engaged in positions which place the lives of others in their hands

Every diabetic who takes more than 20 units of insulin should be impressed with the fact that one preventable reaction which occurs while he is working threatens the position and economic status of all working diabetics Therefore, if the period between breakfast and lunch exceeds or even reaches five hours, a mid-morning lunch of 10 to 20 grams of carbohydrate should be planned All between meal feedings should be calculated as part of the dietary prescription, and not given in addition to it

It is well for the nurse to remember that the severity of

NURSE'S QUESTIONS	PATIENT'S ANTICIPATED ANSWER	RESULTING OUTLINE IN NOTEBOOK
1 What does the term "insulin reaction" mean to you, Mr A?	*1 It means that the blood sugar is too low*	1 Insulin reaction (Blood sugar too low)
2 Do you know where the sugar in your blood comes from?	*2 From the food we eat*	
3 What carelessness on your part might bring on an insulin reaction?	*3 If I skipped a meal*	
4 That is right, but there are several other factors which could cause an insulin reaction, and they have for their common denominator a shortage of food A shortage of food, temporary in nature, would result from unusual exercise, a delay in eating, not finishing your meal, or any factor which interferes with absorption of food, such as indigestion, vomiting, or diarrhea Can you think of anything else, besides a food shortage, which would result in an abnormally low blood sugar?	*4 Too much insulin?*	Causes of reaction 1 Too little food a unusual exercise b delay in eating c meal unfinished d indigestion e vomiting f diarrhea
5 Yes, and this could happen in one of two ways By error, you might give yourself too large a dose Or your pancreas might start to produce more insulin		2 Too much insulin a Error in measuring

If the injected dose were not then reduced, you would have too much insulin for the time Now for the symptoms, Mr A Can you remember how you felt the last time you had to fast, or the last time you missed a meal?	5 *I usually get a headache, and I feel hungry and short tempered*	b Improvement in diabetes 3 Symptoms a hunger b headache c nervousness d excessive perspiration e changes in vision
6 *These are the same feelings you would have if your blood sugar became too low, because they indicate a lack of food But during an insulin reaction, the symptoms are more pronounced In addition, you may perspire profusely, and your vision may become altered All told, you feel "jittery" Now, if the blood sugar is too low, what would you take to bring it up to normal levels?*	6 *Something sweet, like candy*	4 Treatment — sugar in some form a candy b coffee with sugar c ginger ale d an orange
7 *That is right, and you ought to carry some form of hard candy with you at all times Within ten minutes after treatment, you will feel all right And if you know the causes of insulin reaction, then you will understand how to avoid the condition However you should always carry an identification card with you which states that you have diabetes as well as the amount of insulin which you take Here is the card which has been made out for you*		

the diabetes is not so readily estimated by the size of the insulin dose as it is by the marked rise or fall in blood sugar levels over a short space of time Usually, the younger the patient, the more labile is the blood sugar level

I AM A DIABETIC

Name Robert Lincoln Telephone No. 2-3456

Street 200 Main City Hartford, Conn.

MY DIET 180 (C) 80 (P) 80 (F) INSULIN UNITS 10 (Regular or crystalline) 40 (Protamine)

IF I AM FOUND ILL and if sugar orange juice or sweetened fluids do not cause definite improvement in 15 minutes,

PLEASE CALL DR. John Anderson, whose telephone number is 4-6789, or send me immediately to a hospital.

Fig 9 Identification card

The outline concerning insulin reactions which the nurse writes in the patient's notebook should be constructed by having the nurse ask the patient questions which may be answered in such a way that they actually form an outline

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VI

THE DIABETIC DIET

DIET is the most important single factor in the treatment of diabetes For several years after the discovery of insulin, diet was often considered subordinate to insulin by physicians and by diabetic patients Long-duration diabetes and time, however, have proved the fallacy of this theory, for the diabetic who survives twenty years by virtue of insulin alone is the diabetic who demonstrates the degenerative ravages of the disease

HISTORY OF TREATMENT BY DIET

To appreciate the excellence of modern diabetic diet prescriptions, the nurse should have some knowledge of the earlier types of diet therapy which were prevalent before the discovery of insulin The common denominator of these pre-insulin dietary prescriptions was starvation, and the ultimate aim in treatment was not normalcy, but life itself

From the year 1776, Rollo's patient, Captain Meridеth, is remembered as the first diabetic patient whose condition improved on a specific diet The diet consisted of bread, butter, meat, and rancid fat, which were allowed freely Little imagination is required to understand that the success of this dietary treatment depended upon the intake of rancid food which produced loss of appetite for all foods, and thus a volitional semi-starvation resulted

Later, when sugar was recognized in the urine of diabetic patients, carbohydrate was entirely excluded, but free intake of protein and fat was permitted The unfortunate victims of this regimen developed acidosis and died of diabetic coma (Diabetic coma is more fully discussed in Chapter VII)

In 1914, the Guelpa routine for diabetic regulation gained a limited degree of favor This program was arranged in cycles of three days' duration during which time the patient was fasted and purged If his urine was not sugar-free at the end of the cycle, the patient was placed on a "vegetable day" or a "milk day," and then the cycle of fasting and purging was started again Because of the exhaustion experienced by patients who underwent this drastic form of therapy, it did not gain wide popularity At this time Dr Frederick Allen introduced a method of diet therapy which eventually enabled the diabetic to live an average span of four and one half years even though insulin was not yet available More severe cases, particularly children, did not have so good a prognosis Dr Allen was also the first physician to demonstrate the value of weighed diets His initial treatment was actual starvation, for the so called "fast days" included only water, clear coffee, tea, and broth When the patient's urine became sugar free, his diet was built up painstakingly with small additions of carbohydrate, protein, and fat until his individual tolerance was determined Protein was prescribed in subminimal amounts Fats, which supplied the bulk of the calories, were not allowed freely, but they were carefully arranged in a definite ratio to the carbohydrate prescription All components of the diet were carefully weighed on food scales, thus establishing constancy of intake Such a procedure of regulation required weeks of intricate study and calcu-

lation The education of diabetic patients began at this time, for only those diabetics who were carefully trained could survive away from the hospital

Since the diabetic diet of this period contained 25 to 30 grams of carbohydrate, foods like bread, potato, and milk could not be included Vegetables, which comprised the greatest quantitative factor in the diet, were "thrice-cooked," which means that the water was changed three times in the process of cooking, in order to eliminate as much carbohydrate as possible Vegetables prepared in this fashion were the principal source of carbohydrate, they were prescribed even for breakfast when cereal or fruit could not be tolerated An average serving of vegetables contains 5 grams of carbohydrate, so if the patient had a serving for each meal, 15 of the total grams were then used, if he had two servings for dinner and supper, together with one for breakfast, the possible 25 grams allowed would then be used Should the carbohydrate tolerance have been higher than 25 grams, cream was usually added because it also contains fat and additional calories in a palatable form Meat was then added to this basic diet, and more fat in the form of butter and bacon until the desired carbohydrate-fat ratio was reached If at any time sugar reappeared in the urine, the diet was reduced by half for one day, and then absolute fasting was prescribed until the urine became free from sugar These patients did not exceed their meager diets unless they lost all desire to live At this time, before the discovery of insulin, diabetic patients routinely fasted one day weekly to maintain or improve carbohydrate tolerance To physicians like Dr Allen and Dr Joslin should go unlimited credit, for by their undaunted belief in better things to come, they imbued their patients with the courage and desire not only to

live, but to experience lives which were astonishingly normal Many patients of the pre-insulin era survived long enough to enjoy eventually the benefits of insulin which cancelled the need for fasting

DIET IN CONDITIONS OF HEALTH AND DIABETES

Present Conception of Diabetic Diets Generally speaking, there can be no such thing as a standard diabetic diet, for the diet prescription should vary with each patient Basic requirements of normalcy must be considered always because the modern diabetic, unlike those patients of the pre-insulin era, lives long enough to develop deficiency diseases unless the diet is carefully planned

Basic Requirements of Normalcy A textbook on dietetics will supply the necessary details concerning the function and biochemistry of food elements In this chapter, the mere basic requirements will be discussed Although the quantitative factor concerning various vitamins and minerals has not been determined with certainty, the opinions of various authorities may also be found in their standard textbooks on dietetics

The caloric content of the diet should depend on the age, activity, and ideal (not actual) weight of the patient For most adults, 30 to 40 calories for each kilogram of body weight is sufficient Carbohydrates and fats are somewhat interchangeable as a source of calories Thus, persons in the higher income brackets derive many of their calories from cream and butter, those in the lower income brackets use carbohydrates like bread, potato, and macaroni to supply calories Considering merely the caloric requirements, either method is satisfactory if the body weight is approximately correct

Protein is essential for tissue replacement and for the multiplication of cells (growth) Since certain foods

contain complete and others incomplete proteins, the requirement of 1 gram of protein for each kilogram of ideal body weight seems to be a safer standard than the frequently quoted one, ⅔ of a gram per kilogram of weight During normal times, most people take more

TABLE 3

FOOD VALUES

FOOD	GRAMS	MEASUREMENTS	GRAMS OF CARB	GRAMS OF PROTEIN	GRAMS OF FAT
Vegetables 5%	150	1 cup	5	3	0
Vegetables 10%	75	½ cup	5	1	0
Saltines	—	4	10	1	1
Cereal	30 or 240	1 cup	20	5	2
Potato	90	1 medium	18	3	0
Bread	30	1 slice	18	3	0
Macaroni rice	90	½ cup	13	3	0
Milk	180	¾ cup	9	6	6
Milk	240	½ pint	12	8	8
Egg	—	1	0	6	6
Meat fish	60	average portion	0	16	10
Cheese	15	1 inch cube	0	4	6
Bacon	15	2 long strips	0	3	8
Light cream	30	2 tablespoons	1	1	6
Heavy cream	15	1 tablespoon	1	1	6
Butter	10	2 teaspoons	0	0	8
Oil	15	1 tablespoon	0	0	15
Mayonnaise	10	1 teaspoon	0	0	8
Ice cream	50	small scoop	10	2	8
Jello	50	small portion	10	3	0
Peanuts	45	5c bag	10	12	14
Peanut butter	30	2 tablespoons	5	9	14

Note All measurements level unless otherwise specified

protein than they actually require, but the surplus is used merely for calories Comparatively speaking, the families in the upper income brackets have diets with moderate content of carbohydrate (300 to 400 grams), and a relatively high content of protein (100 grams),

based on 25 to 30 calories per kilogram of ideal weight If the patient loses more weight than is desirable on this diet, the total calories may be increased Strangely enough, diabetics seem to maintain their weight on diets which are considered less than normal in caloric content In determining the caloric needs, the body weight is expressed in kilograms rather than pounds Since 1 kilogram equals 2 2 pounds, Mr A's weight would be

$$\frac{150}{2\ 2} \text{ pounds or about 68 kilograms}$$

With a requirement of 25 to 30 calories per kilogram, his diet should contain between 1700 and 2040 calories He may be given two diets, one of 1700 calories for days when he does not work, and one of 2000 calories for days when he does work If his work is not of a laborious nature, he may be given a diet of approximately 1700 to 1800 calories for all purposes

Since each gram of carbohydrate or protein yields 4 calories, and each gram of fat yields 9 calories, the diet might be arranged in one of several combinations according to the physician's prescriptions Three examples are

Carbohydrate	180 grams × 4 =	720 calories
Protein	90 grams × 4 =	360 "
Fat	80 grams × 9 =	720 "
	Calories	1800 "
Carbohydrate	160 grams × 4 =	640 calories
Protein	90 grams × 4 =	360 "
Fat	90 grams × 9 =	810 "
	Calories	1810
Carbohydrate	180 grams × 4 =	720 calories
Protein	80 grams × 4 =	320 "
Fat	85 grams × 9 =	765 "
	Calories	1805

If the prescription of C 180 P. 80 F 85 is selected, the food is then divided into at least three major meals throughout the day and one minor meal for bedtime The total carbohydrate, minus the allowance reserved for a bedtime lunch, is then divided among the three major meals, but not necessarily equally Sometimes the remainder is divided into thirds, but it may be planned so that the breakfast contains less carbohydrate than do the other meals If one meal is to have a higher carbohydrate content than the others, this meal is best taken in the evening unless the patient works at a laborious occupation Every diabetic who takes protamine zinc insulin should have a lunch at bedtime to prevent an excessive lowering of the blood sugar during the long fast of the night

Mr A's diet might be arranged according to the forms of Figure 10 The diet interpretation is usually acceptable to the physician when the total number of grams in each component part is within 3 grams of the original prescription For example, the prescription of C 180 P 80 F 85 would be satisfactory if the final figures obtained were C 181 P 83 F 84

The Weighed Diet A weighed diet leaves little margin for error It does not really cause the patient inconvenience since he quickly learns several "short cuts," like that of weighing butter, cream, and milk in the morning for the entire day At the beginning of treatment, the patient should plan to weigh all meals eaten at home for at least three months Many years have passed since the diabetic was expected to take his food scales to the restaurant At the end of three months, he should develop enough acumen to estimate quantities with a fair degree of accuracy However, his food scales should not then be set aside or sold Instead, all food should be weighed

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Name Date

Breakfast			Dinner			Supper			Total Daily Diet	
Crys Insulin Units Prot. Insulin Units			Crys Insulin Units			Crys Insulin Units			C P F Cal 182—82—83—1817	
	Grams	Portions		Grams	Portions		Grams	Portions		Grams
Eggs		1	Eggs			Eggs			Eggs	1
Meat, cooked			Meat, cooked	60		Meat, cooked		60	Meat, cooked	120
Bacon			Bacon			Bacon			Bacon	
5% Veg			5% Veg	150		5% Veg		150	5% Veg	300
10% Veg			10% Veg	75		10% Veg		75	10% Veg	150
Oat., dry	15		Oat , dry			Oat., dry			Oat , dry	15
(Oat , cooked)	(120)		Oat , cooked			Oat , cooked			Oat , cooked	
Uneedas			Uneedas			Uneedas			Uneedas	2
Butter	5		Butter	10		Butter		15	Butter	30
Cream, 20%	30		Cream, 20%			Cream, 20%			Cream, 20%	30
Milk			Milk			Milk			Milk	480
Orange	150		Orange	150		Orange		150	Orange	450
Cheese			Cheese			Cheese			Cheese	
Potato			Potato			Potato		90	Potato	90
Bread	30		Bread	30		Bread		30	Bread	90

Allow 1 pint of milk for entire day Save a portion for bedtime and take with 2 Uneeda biscuits or 4 saltines

Fig 10 Sample of discharge diet in grams

at least one day in every week so that accuracy of estimation may be maintained All foods are weighed in the state in which they are eaten Thus, meat is weighed after cooking, and fruit would be weighed uncooked if it is eaten this way Toast is an exception to the rule If a slice of bread weighing 30 grams goes into the toaster, it may come out weighing several grams less This loss in weight results from loss of moisture, not of starch or nutriment

Measured Diets Measured diets are not quite so satisfactory as weighed diets, but the conscientious patient does well to use them, provided that the person who writes the diet uses positive terms and expressions which leave little margin for misunderstanding For instance, rather than writing 60 grams of potato for dinner and supper, as one could do satisfactorily on a weighed diet, 90 grams for a single meal would be better planning because 90 grams of potato could be described as a small potato, but 60 grams would be described as half a medium sized potato The person who writes the diet in terms of household measurements should also avoid items such as ½ slice of bread Instead, the food should be arranged so that reasonable sized portions are prescribed Rather than prescribing ½ a medium sized potato and ½ slice of bread for dinner and supper, it would be advisable to prescribe 1 small potato without bread for dinner, and 1 entire slice of bread without potato for supper Such planning would be unnecessary in a weighed diet, for the patient is accustomed to ' shaving" portions constantly

Such foods as meat, fruit, and potato are particularly difficult to measure accurately An ideal plan would be for the clinic to purchase several scales for rental purposes The new diabetic patient could then borrow the

Name Date

Breakfast			Dinner			Supper			Total Daily Diet	
Crys Insulin Units Prot Insulin Units			Crys Insulin Units			Crys Insulin Units			C P F Cal 180—80—85—1805	
	Grams	Portions		Grams	Portions		Grams	Portions		Grams
Eggs		1	Eggs			Eggs			Eggs	1
Meat, cooked			Meat, cooked	average	serving	Meat, cooked	average	serving	Meat, cooked	120
Bacon			Bacon			Bacon			Bacon	
5% Veg			5% Veg	freely		5% Veg	freely		5% Veg	300
10% Veg			10% Veg	½ cup		10% Veg	½ cup		10% Veg	150
Oat, dry			Oat, dry			Oat, dry			Oat, dry	
Oat, cooked	½ cup		Oat, cooked			Oat, cooked			Oat, cooked	120
Uneedas			Uneedas			Uneedas			Uneedas	2
Butter		1 tsp	Butter		2 tsp.	Butter		3 tsp	Butter	30
Cream, 20%		2 tbsp	Cream, 20%			Cream, 20%			Cream, 20%	30
Milk			Milk			Milk			Milk	480
Orange		1 med	Orange		1 med	Orange		1 med	Orange	450
Cheese			Cheese			Cheese			Cheese	
Potato			Potato			Potato		1 med	Potato	90
Bread		1 slice	Bread		1 slice	Bread		1 slice	Bread	90

Allow 1 pint of milk daily. Save a portion for bedtime, and take with 2 Uneeda biscuits or 4 saltines

Fig 11 Sample of discharge diet in household measurements

scales for a specified length of time, or until he became familiar with the size of the food portions, or the diabetic of some years standing could re-borrow the scales if he felt the need for greater accuracy

The nurse should scan the diet which she has written to ascertain whether or not the mineral and vitamin contents are adequate according to contemporary standards It is generally agreed by most authorities that 0 7 gram of calcium daily is sufficient for the adult, and also that phosphorus is found in those foods which contain calcium Therefore, if the diet is adequate in calcium content, it would have an adequate content of phosphorus A pint of milk will usually guarantee the calcium and phosphorus requirement for an adult, and this amount should be included in every diabetic diet

The fact that vitamin A or its precursor is found in all pigmented vegetables and that vegetables play a place of prominence in the diabetic diet, means that diabetic patients rarely would have a vitamin A deficiency because of an inadequate intake

Since B complex vitamins are water-soluble, diabetic patients frequently suffer from deficiency, although the diabetic diet provides vitamin B complex When the diabetic condition is uncontrolled and polyuria is present, the diabetic loses many water-soluble vitamins, therefore many physicians prescribe supplementary vitamin B complex as a prophylactic measure The medication is usually prescribed in capsule form, because elixirs and syrups contain a high percentage of sugar in concentrated form In addition, those diabetics whose disease is of ten years' duration or longer, frequently have no free hydrochloric acid, which is essential to the utilization of vitamins in the B complex group

Vitamin C is found abundantly in the diabetic diet

TABLE 4 APPROXIMATE EQUIVALENT IN GRAMS

1 EGG EQUALS
- cheese, 15 grams
- bacon, 15 grams
- meat, fish, or chicken, 30 grams
- cottage cheese, 30 grams, plus butter, 5 grams (or sour cream, 15 grams)
- peanut butter, 15 grams

CEREAL, 15 GRAMS DRY WEIGHT EQUALS
- cooked cereal, 120 grams
- shredded wheat biscuit, ½
- bread, 15 grams
- orange, 100 grams

BUTTER, 10 GRAMS EQUALS
- oil or mayonnaise, 10 grams
- 20% cream, 30 grams
- 40% cream, 15 grams
- bacon, 15 grams

BREAD, 15 GRAMS EQUALS
- Uneedas, 2, saltines, 4
- potato, 45 grams
- pumpernickel, 20 grams

MEAT, 60 GRAMS EQUALS
- any meat or fowl, 60 grams
- fat-containing fish, 60 grams
- fat free fish, 80 grams, plus 10 grams of butter (extra)
- eggs, 2

5% VEGETABLES, 150 GRAMS EQUALS
- 10% vegetables, 75 grams
- Uneeda, 1
- potato, 30 grams
- bread, 10 grams

POTATO, 90 GRAMS EQUALS
- any 20% vegetable, 90 grams
- bread, 30 grams
- sweet potato, 80 grams
- potato chips, 35 grams, and with 10 grams of butter subtracted (If potato is baked, add 20 grams for skin)

[illegible]

Data from E P Joslin's Diabetic Manual, Lea Febiger, Phila

TABLE 5 APPROXIMATE EQUIVALENTS IN HOUSEHOLD MEASURES OF VARIOUS FOODS

1 EGG EQUALS
- cream cheese, 1 tablespoon
- loaf cheese, 1 inch cube
- bacon, 2 long strips
- cottage cheese, 2 tablespoons, plus 1 teaspoon butter, or 1 tablespoon sour cream
- peanut butter, 1 tablespoon
- meat, very small portion

CEREAL, ½ CUP EQUALS
- any hot or dry cereal (except Grapenuts) ½ cup
- shredded wheat, ½ biscuit
- bread, ½ slice

BREAD, 1 SLICE (MAY BE WHITE OR DARK, TOASTED OR NOT) EQUALS
- cereal, 1 cup
- Uneedas or grahams, 4
- saltines, 8
- potato, 1 medium
- rice, macaroni, lima beans, 3 rounded tablespoons
- corn, 1 ear of medium size
- orange, 1 medium

5% VEGETABLE (MAY BE TAKEN FREELY)
- 10% vegetable, ½ cup
- Uneeda, 1, saltines, 2

BUTTER, 1 PAT (OR 2 TEASPOONS) EQUALS
- any oil, 2 teaspoons (except mineral oil)
- mayonnaise, 2 teaspoons
- light cream, 2 tablespoons
- heavy cream, 1 tablespoon

MEAT, AVERAGE PORTION
- any kind—cold cuts, pork, etc
- fat-containing fish, average portion
- fat free fish, average portion plus 2 teaspoons of butter

GENERAL INSTRUCTIONS

All measurements are level unless otherwise specified A standard measuring or cooking cup should be used

Each meal is a unit, and items of food should not be subtracted from one meal and carried to another

Avoid all sugar, pastry, and fried foods

Avoid all so-called diabetic foods

Data from E. P Joslin's Diabetic Manual, Lea & Febiger, Phila

because so many of the vegetables and fruits included such as oranges, bananas, grapefruit, tomatoes, and potatoes are excellent sources Vitamin C, however, is also water-soluble, so the patient with diabetes may have a deficiency

RELIGIOUS DIETARY LAWS

KOSHER DIET

Since many diabetics are of the Hebrew race and Jewish religion, the nurse should understand some of the rudiments of the Jewish dietary laws The orthodox Jew will make no concessions to his dietary laws If the person who writes the diet does not consider the Kosher laws the patient will resign himself to the fact that he cannot follow a diabetic diet since it interferes with his religious life On a Kosher diet, pork products are not used, and dairy products are not served at the same meal with meat Thus, butter, milk, cream, and cheese are not included in the main meal which contains meat If Mr A were a Jewish patient, his diet of C 180 P 80 F 80 might be written as in Fig 12 By referring to the tables of substitutes (Tables 4 or 5), the patient should be in structed that he may have 60 grams of fish for his supper if the egg and the cheese are omitted

During the Passover, which lasts eight days, no leaven breads or cereals are permitted Matzoth, which is sold in both round and square shapes and comes in individual servings, may be substituted Each serving is the approx imate equivalent of 1 slice of bread Thus, the patient could have 1½ matzoth for breakfast in place of both bread and cereal, and 1 serving for dinner and supper in place of each slice of bread During the actual fast days such as Yom Kippur, the physician usually advises his diabetic patients not to fast, since even minor fasting

Name Date

Breakfast			Dinner			Supper			Total Daily Diet	
Crys. Insulin Prot Insulin		Units Units	Crys Insulin		Units	Crys Insulin		Units	C P F Cal 180—80—80—1760	
	Grams	Portions		Grams	Portions		Grams	Portions		Grams
Eggs		1	Eggs			Eggs		1	Eggs	2
Meat, cooked			Meat, cooked	90	large	Meat, cooked			Meat, cooked	90
Bacon			Bacon			Bacon			Bacon	
5% Veg			5% Veg	150	freely	5% Veg	150	freely	5% Veg	300
10% Veg			10% Veg	75	½ cup	10% Veg	75	½ cup	10% Veg	150
Oat., dry	15	1 tbsp	Oat , dry			Oat , dry			Oat , dry	15
Oat , cooked	(120)	(½ cup)	Oat , cooked			Oat , cooked			Oat , cooked	
Uneedas			Uneedas			Uneedas			Uneedas	2
Butter	10	2 tsp	Butter			Butter	15	3 tsp	Butter	25
Cream, 20%	30	2 tbsp	Cream, 20%			Cream, 20%	30	2 tbsp	Cream, 20%	60
Milk			Milk			Milk			Milk	480
Orange	150	1 med	Orange	150	1 med	Orange	150	1 med	Orange	450
Cheese			Cheese			Cheese	15	1 tbsp	Cheese	15
Potato			Potato	90	1 med	Potato			Potato	90
Bread	30	*1 slice*	*Bread*	30	*1 slice*	*Bread*	30	1 slice	Bread	90

Allow 1 pint of milk daily Save a portion for bedtime and take with 2 Uneeda biscuits or 4 saltines

Fig 12 Kosher diet in grams and household measurements

TABLE 6

MEASURES OF FRUITS *YIELDING 10* AND 15 GRAMS OF CARBOHYDRATE

	EQUIVALENT OF 1 SMALL ORANGE, 10 GRAMS CARBOHYDRATE		EQUIVALENT OF 1 MEDIUM ORANGE, 15 GRAMS CARBOHYDRATE	
	Grams	Household Measure	Grams	Household Measure
Grapefruit	150	½ large	225	1 entire small
Watermelon	150	average serving	225	1 large serving
Canteloupe	150	½ *small*	225	½ large
Strawberries	150	1 cup	225	1½ cups
Blackberries	120	¾ cup	180	1 cup
Pear	90	1 small	135	1 medium
Peach	90	1 medium	135	2 small
Apricots	80	2 whole	120	3 whole
Raspberries	80	½ cup	120	1½ cups
Plums	80	2 average	120	3 whole
Apple	70	½ medium	105	1 small
Blueberries	70	½ cup	105	¾ cup
Cherries	60	½ cup	90	¾ cup
Banana	50	½ medium	75	1 small
Prunes, cooked	50	2	75	4
Ice cream	50	1 small scoop	75	average portion
Jello	50	small portion	75	average portion
Bread	15	½ slice	30	1 slice

Compiled from E P Joslin's Diabetic Manual, Lea and Febiger, Philadelphia

is hazardous for diabetics Conservative Jews are less strict in following these laws and customs than are orthodox Jews

VARIATIONS FOR CATHOLIC PATIENTS

The Catholic religion offers few dietary problems to the diabetic patient There are frequent days of meat-abstinence including every Friday, but fish provides an excellent substitute for meat By referring to Tables 4 and 5 the nurse will see that an egg will replace 15 grams of bacon Thus, on Friday, the Catholic patient may satisfactorily omit his bacon, and then add a second egg for that day Few Catholics are obliged to fast during the designated days of fasting such as those of the Lenten season All children, all persons who are in ill health or stages of infirmity, all working people and their families are excused from fasting Catholic patients who are allergic to fish may receive a special dispensation which permits them to eat meat on the days of abstinence Many Catholics are unaware of these special dispensations, but the nurse should direct them to their clergy for consultation and advice

INDIVIDUAL FOODS

VEGETABLES

Although the vegetables listed (Table 7) as containing 5 per cent carbohydrate actually range in carbohydrate content from 1 per cent to 5 per cent, they are reckoned as 3 per cent in calculating the diet The term "5% vegetable," then, is merely a convenient one which includes all vegetables in the low carbohydrate group In the same manner, vegetables in the 10 per cent carbohydrate group are actually reckoned as containing approximately 6 per cent carbohydrate Vegetables may be canned or fresh, cooked or uncooked Since salt is

allowed in normal amounts, no special preparation is required for cooking Potatoes may be boiled, baked, or

TABLE 7

VEGETABLES ACCORDING TO PERCENTAGE OF CARBOHYDRATE

5% VEGETABLES	5% VEGETABLES	10% VEGETABLES	20% VEGETABLES
Lettuce	Tomatoes	String beans	Potato
Cucumbers	Water cress	Brussel sprouts	Parsnip
Spinach	Sea kale	Pumpkin	Lima beans
Asparagus	Cauliflower	Turnip	Corn
Rhubarb	Eggplant	Squash	Rice
Endive	Cabbage	Carrots	Macaroni
Sauerkraut	Radishes	Onions	
Beet greens	Young string beans	Young peas	
Dandelions	Broccoli	Beets	
Swiss chard	French artichokes	Tomato juice	
Celery	Green peppers		
Mushrooms	Summer squash		

mashed If milk or butter is used in the cooking or preparation, these foods or their equivalents must be subtracted from the dietary allotment

BREAD

The bread used may be white or dark, since the carbohydrate content of both is quite similar Formerly, the use of dark bread was encouraged because it had a higher vitamin content, but so long as white flour is fortified with additional vitamins, there is no preference other than that determined by taste Plain rolls may be substituted for bread When food scales are used, this is a simple substitution, but when the patient is using a measured diet, he should be instructed to start with rolls which come in a package so that the total weight of all the rolls may be read directly from the carton Thus, if

6 rolls together weigh 5½ to 6½ ounces, it will be safe enough to consider each roll as weighing approximately 1 ounce, and therefore equal to a slice of bread Saltines are placed on the list because patients often substitute them for bread when the butter allowance has been converted into such foods as mayonnaise or cream Any small, unsweetened cracker may be used in place of saltines If larger sized crackers such as Uneeda biscuits or graham crackers are used, the patient takes half as many as he would of saltines

CEREAL

The food values given for cereals vary greatly, but the diabetic is not usually taxed with a list of cereals and their individual food values Actually, the differences are not great enough to upset the metabolism If the patient lives alone, after he weighs out 15 grams (or measures 1 tablespoon) of raw cereal, adds the amount of water and salt desired, he is free to eat the entire cooked product without further measuring If the rest of the family eats hot cereal, one should not instruct the diabetic to cook his portion in a separate boiler Instead, 120 grams cooked (or ½ cup) is considered the approximate equivalent of 15 grams dry weight, since cereal swells about 8 times after water has been added and the food cooked If prepared cereals such as cornflakes are used, the patient would take 15 grams also By measure, this would be ½ to ¾ of a cup of any cereal except Grapenuts Grapenuts is heavier for its volume, and should not be used unless the patient has food scales

MILK

Every glass of milk has between 8 and 12 grams of sugar, depending on whether the glass contains 6 or 8

ounces Because of the relatively high content of sugar, and the ease with which milk may be taken thoughtlessly, it was not generally included in diabetic diets until after 1930 when the carbohydrate content of the diets more nearly approached the present level Patients must still be warned of the high food value of milk lest they use it indiscriminately, for the indiscriminate use of milk is a common cause of uncontrolled diabetes Unsweetened evaporated milk is ordinary milk which has been dehydrated Thus, canned milk is concentrated so that it contains approximately twice the food value of whole milk for a given volume Diabetics may use unsweetened canned milk, but they should be taught to take ½ pint daily to replace 1 whole pint of fresh milk

MEAT

Meat of all kinds is permissible on the diabetic diet The patient is not confined to the use of expensive meats like steaks and chops, for cold cuts and frankfurters are as nutritious, and pork is a better source of thiamine Lean meat should be used, or the margin of fat removed from other kinds If the patient enjoys some of the fat, he may use it by omitting fat from his diet in the form of butter or cream Canned or salted meats are also permissible

FISH

Fish is classified according to whether or not it contains fat (Table 8) Fish which contains fat is used interchangeably with meat The use of fat free fish calls for the addition of fat to the diet The additional fat may be used as butter sauce for hot fish, or as mayonnaise if salad is taken The fish may be fresh or canned Patients

should be instructed not to fry fish since this process requires a large amount of fat together with corn meal or bread crumbs. An average sized lobster is the equiva-

TABLE 8

ESSENTIALLY FAT FREE FISH AND SEA FOOD

NAME	PERCENTAGE OF FAT
Bass, sea	1 0
Bluefish	1 2
Cod	0 2
Flounder	0 6
Haddock	0 3
Hake	0 7
Perch, yellow	0 8
Pickerel	0 5
Whitefish	1 4
Clams	1 0
Crabs	1 5
Crayfish	0 5
Lobster	1 9
Mussels	1 1
Oysters	1 2
Shrimps	0 4
Scallops	0 1

lent of 60 grams of meat, and since lobster is fat-free, extra butter or mayonnaise should be used

EGGS

Eggs vary in size, but the difference is not great enough in routine marketing to demand weighing of eggs by the patient who is usually instructed to avoid the purchase of pullet eggs, out-sized, or double yolked eggs. Eggs contain a large percentage of cholesterol and because

cholesterol is conspicuous in the blood vessels of those people with arteriosclerosis, many authorities believe that diabetics should not eat more than two eggs daily In the diabetic diet, eggs may be prepared in any style which the patient desires However, fried eggs require extra fat If the patient is allowed bacon, the bacon could be weighed raw, and then all the fat left in the pan would have been calculated, and correctly used for frying the eggs Otherwise, the patient would have to omit fat in the form of butter or cream to obtain fat for frying

CHEESE

Cheese is similar to meat in content of protein, but it contains almost twice as much fat Therefore, when cheese is used as a substitute for meat, the butter or cream muct be reduced proportionately Cottage cheese is an exception since it contains no fat Therefore, when cottage cheese is used as a substitute for fish or meat, fat must be added to the diet

CREAM

Cream usually contains 20 per cent or 40 per cent fat Twenty per cent cream is often referred to as coffee cream or light cream Forty per cent cream is sometimes whipping cream The diabetic diet is more often written in terms of 20 per cent cream, which contains 6 grams of fat to the ounce Should the patient desire whipping cream, he would take ½ of his portion of light cream Diabetic patients frequently make the mistake of thinking that fat may be taken freely since it contains such a small amount of potential carbohydrate For this reason, the teaching nurse must emphasize the need for taking only the prescribed allowance

BUTTER AND MARGARINE

These two foods contain a similar percentage of fat, but unless the margarine is fortified, it does not contain the vitamins which are found in butter

OILS

All oils, except mineral oil, contain assimilable fat which comprises almost their total weight Many Italian patients prefer oil to butter

NUTS

Nuts always offer a problem in the diabetic diet Their carbohydrate is low enough for inclusion, their protein content high enough to be useful, but the fat content is extremely high The uninstructed or the careless diabetic

TABLE 9

FOOD VALUES OF NUTS

NAME	AVERAGE PORTION	GRAMS	CARB	PROTEIN	FAT
Almond	10	15	3	3	8
Brazil	4	30	2	5	20
Butternut	6	10	1	3	6
Cashew	10	15	4	3	7
Chestnut	4	25	10	2	2
Litchi	10	25	20	2	0
Pecan	3	12	2	1	9
Walnut	3	18	2	5	10

frequently gets into difficulty because he uses them in the place of candy One is almost tempted to instruct the careless diabetic to avoid nuts entirely, but they offer great pleasure to the patients who eat them in the correct amount (Table 9)

SO-CALLED DIABETIC FOODS

If the nurse will read carefully the list of foods included in the modern diabetic diet, she will find no "special

foods" listed On the contrary, she will find that all of the foods listed are those which are found in the larder of the average family Unless the patient is a child, special diabetic foods have no place in the modern diabetic regimen, for not only are they costly and unnecessary, but they constantly remind the diabetic of his disease However, one still sees gluten bread and flour for use in diabetic diets advertised by commercial houses Gluten flour comes from the albuminous part of wheat flour. It contains less starch than does ordinary flour, but more protein Since 58 per cent of ingested protein is potential carbohydrate, the nurse will see the fallacy of using gluten bread in diabetic diets Before 1920, when protein had not been generally recognized as potential carbohydrate, gluten bread was used commonly in diabetic diets Gluten bread is costly, soggy, and unpalatable Certain stores which are self-designated as "health food stores" sell many such costly items which the diabetic does not require, and which will actually interfere with the control of his diabetes When the diabetic diet was extremely limited in the pre insulin era, the use of special diabetic foods was understandable, but with the present type of diabetic diets, special foods have lost their reason for being

SACCHARIN

Saccharin can hardly be classified as a food, but it really has a recognized place in the diabetic diet There is no need to restrict the amount taken since saccharin is a harmless coal tar product It is about 300 times sweeter than sugar, and it comes in tablet, liquid, and powder preparations The tablets are most widely used, and they are prepared to contain ¼, ½, or 1 grain of saccharin Some authorities on diabetes discourage the

use of saccharin because they believe its use enables the patient to retain his memory and desire for sweet foods On the other hand, many diabetic patients are more satisfied with a diabetic diet if it retains some of their normal taste pleasures Undoubtedly, the patient would be fortunate if he could learn to enjoy coffee without sweetening Yet, if the addition of ¼ or ½ grain of saccharin makes his coffee more enjoyable, there is no need to deprive him of it

If saccharin is used on cereal, the nurse should instruct the patient to dissolve a tablet in a teaspoon of hot water This water may then be added directly to the hot cereal, or dissolved in the milk which is to be poured over the cold cereal Saccharin in powder form is difficult to use since the smallest measurable amount usually contains more than 1 grain of the product When cooked food such as rhubarb sauce requires saccharin, it is added after the food has been cooked A small amount of sodium bicarbonate added to tart foods such as rhubarb or lemonade enables the saccharin to become more effective as a sweetening agent

ALCOHOL

In the pre-insulin days, alcohol was sometimes prescribed by the physician because it provided calories without adding carbohydrate, protein, or fat As a source of calories, alcohol is no longer considered desirable When the patient asks about using it, the nurse should refer him to the physician for his answer Some physicians do allow their patients to partake of alcoholic drinks such as whisky, scotch-and-soda, dry martinis, or the sour red wines which Italian patients desire Other physicians do not permit the use of alcohol because they disapprove of it in general, or because they feel that the use of alcohol

exposes the patient to the danger of being unable to recognize the symptoms of insulin reaction, since alcohol is frequently taken before meals, as a social custom, and this is the time at which the blood sugar is lowest Within

TABLE 10
VALUES OF ALCOHOLIC BEVERAGES

NAME	AVERAGE PORTION	CC	ALCOHOL	CARB	PROTEIN
Ale porter	1 cup	240	13	9	2
Beer	1 cup	240	10	13	2
Brandy	1 brandy glass	30	11	0	0
Champagne	1 wine glass	100	11	4	0
Cider	1 cup	240	9	7	0
Gin	1 brandy glass	30	10	3	0
Liqueurs	1 cordial glass	20	6	6	0
Port wine	1 wine glass	100	15	10	5
Red wines	1 wine glass	100	10	1	5
Rum	1 brandy glass	30	10	0	0
Sherry	1 wine glass	100	15	5	5
Vermouth	1 wine glass	100	16	6	0
Whisky	1 brandy glass	30	13	0	0
White wines	1 wine glass	100	11	2	5

any group of physicians, there will be difference of opinion concerning the use of alcohol by diabetic patients The nurse should advise the patient to avoid the use of alcohol until he has had the opportunity to discuss the question with his physician (See Table 10)

TOBACCO

Tobacco is not a food, but the patient usually asks about its use during the dietary instruction period Most physicians permit the use of tobacco in moderation When tobacco is forbidden on the diabetic program, it is usually because nicotine acts as a vasoconstrictor Many diabetics have poor circulation because of extensive arteriosclerosis, and the use of a vasoconstrictor would further impede the circulation Many ophthalmol-

ogists believe that toxic amblyopia (reduced vision) occurs more frequently in diabetics than in others, and in the presence of amblyopia, tobacco is believed to be of etiological significance Most diabetics who smoke at all smoke excessively, particularly as a social factor If the dessert is one which the diabetic cannot eat, or if refreshments served following a social event are those which he is not permitted, he usually resorts to a cigarette to avoid the embarrassment of doing nothing Whether or not the diabetic person should smoke, or how much he should smoke are questions which must be referred directly to the physician who knows of the vascular or visual dis turbances in a given patient

DIABETIC MENUS AND RECIPES

With the present diabetic diets, special menus are not needed, they should be replaced by suggestions for altering the family meals enough to suit the diabetic For instance, if strawberry shortcake were the dessert, the member of the family who cooks could prepare biscuit-dough shortcake rather than a sweet one, and then set aside a portion of fruit without sugar Whipped cream could be used by curtailing the fat allowance elsewhere If the patient includes shortcake, then he omits bread in the usual form of a slice from that meal Thus, the patient merely learns how much of the various foods he should take when meat, potato, vegetables, bread, butter, cream, and eggs are served on the family menu Generally speaking, he omits sugar and true pastry, and for dessert he takes fruit, ice cream, jello, or crackers and cheese Coffee and tea are taken in moderate amounts as they are in normalcy (Table 6)

Diabetics were formerly instructed to make a special mayonnaise of mineral oil because it, unlike other oils

passes through the gastro intestinal tract without absorption, and so calories are not added to the diet However, in the light of recent knowledge, mineral oil as it passes through the intestine, takes with it the fat soluble vitamins If the patient ate a salad which contained vitamin A, and he added mineral oil salad dressing to it, he would lose most of the vitamin A which the salad contained Therefore, it would seem important to point this fact out to the patient so that he could learn how to substitute with regular mayonnaise, or so that he could acquire a taste for undressed salads

The term "diabetic ice cream" indicates a product which is prepared from 40 per cent cream A medium priced commercial brand is preferable to diabetic ice cream because although the fat content of the former is fairly high, it is still appreciably less than that found in a product which is made with heavy cream The nurse may question the use of ice cream on diabetic diets, but repeated random analyses have shown that the average commercial ice cream contains about 20 per cent carbohydrate, and such a figure is not prohibitive However, since ice cream is taken in place of fruit which does not usually contain fat, patients are instructed to use it not oftener than once or twice a week

BEDTIME LUNCHES

As stated earlier, every diabetic who takes protamine insulin should have a lunch at bedtime to prevent an excessive lowering of the blood sugar during the long fast of the night The bedtime lunch usually consists of 15 to 25 grams of carbohydrate in a form which is not too rapidly assimilable Since the type of sugar found in fruit and fruit juice is assimilated so rapidly that it reaches the blood stream in a matter of minutes, such

food would offer no protection against insulin reaction after midnight The carbohydrate of the bedtime lunch should be in the form of starch since the metabolic process in the breakdown of starch takes longer than that of sugar, and the patient would then be protected for a correspondingly longer time against hypoglycemia For this reason, saltines or other crackers are frequently used as a bedtime lunch The addition of protein and fat to carbohydrate makes the absorption of the feeding even more prolonged since they complicate the process of digestion still more For this reason, a glass of milk is frequently added to the crackers Should the patient prefer coffee or tea for a beverage, peanut butter or cheese will provide a desirable mode of satisfying the requirements

RESTAURANT MEALS

For the patient who eats in a restaurant occasionally, or once daily, there is no problem When the patient must eat all his meals out it is costly for it often means ordering a la carte The difficulty of eating all meals in a restaurant lies in the fact that the special dinners rarely contain unsweetened fruits for dessert, and the less expensive meats are usually of a type which are unpalatable when they are served without gravy Rarely does the diabetic diet contain more than 15 grams of cereal for breakfast Yet, in restaurants, cold cereals are served in paper packages which hold 1 ounce or 30 grams Hot cereals, too, come in larger sized portions than the diet prescribes To leave half the serving is logical, and yet the average person resents paying for something which he cannot use Therefore, in planning a diet for the patient who eats all his meals out, individualization is particularly essential The following diet is an example

SERVING		GRAMS	CARB	PROTEIN	FAT
Breakfast					
Grapefruit	½	150	10	0	0
Eggs	2	—	0	12	12
Bacon	4 short strips	15	0	3	8
Toast	2 slices	60	36	6	0
Butter	1 pat	10	0	0	8
Cream (coffee)	2 tablespoons	30	1	1	6
Dinner or Luncheon					
Sandwich					
Bread	2 slices	60	36	6	0
Tomato lettuce			Food values negligible		
Chicken	small portion	30	0	8	3
Mayonnaise	1 teaspoon	10	0	0	8
Milk	½ pint	240	12	8	8
Dinner					
Tomato juice	1 glass	180	12	3	0
Meat	average portion	60	0	16	10
Vegetable	a serving	—	5	3	0
Potato	1 medium	90	18	3	0
Bread	1 slice	30	18	3	0
Butter	1 pat	10	0	0	8
Cream (coffee)	2 tablespoons	30	1	1	6
Dessert					
Crackers	4	—	10	1	1
Cheese	1 inch cube	15	0	4	6
Bedtime					
Saltines	6	—	15	2	2
Peanut butter	1 tablespoon	15	5	9	14
			164	89	92

Actually, the fat content of such a diet might be some what higher than those indicated in the totals because a varying amount of butter is used on vegetables before they are served, or certain meats might contain relatively higher percentages of fat than would others

It is possible to have greater variety at less expense

when the dinner is eaten at home, for there is an unlimited variety of fruits and vegetables according to the season, but if the diabetic eats breakfast and dinner at home, the noon meal could then consist of a relatively inexpensive sandwich lunch

BOX LUNCHES

When the diabetic plans to carry a lunch box meal, the food value of the original plate dinner must first be determined, and the lunch would then be planned as an approximate equivalent The noon meal shown in Figure 10 would be analyzed as follows

	GRAMS	CARB	PROTEIN	FAT
Meat.	60	0	16	10
5% Vegetable	150	5	3	0
10% Vegetable	75	5	1	0
Bread	30	18	3	0
Butter	10	0	0	8
Orange	150	15	0	0
Milk	60	3	2	2
		—	—	—
		43	23	18

The box lunch total figures should come within 3 grams of the totals found in the usual meal For example

	GRAMS	CARB	PROTEIN	FAT
Bread	60 (2 slices)	36	6	0
Meat	60 (average dinner portion)	0	16	10
Orange	100 (1 small)	10	0	0
Celery, tomato, or other suitable vegetables			Negligible	
		—	—	—
		46	22	16
Thermos of soup or tea if desired				

Obviously, such a diet would not satisfy hard-working men or women For such individuals, two diets should be planned, one for working days and one for nonworking days At least 60 and as many as 80 grams of carbohydrate should be used for the lunch of a man or woman engaged in laborious work, particularly when the patient has an early breakfast When breakfast is eaten before 7 00 A M, a midmorning snack should be planned This snack would be in addition to the 60 grams of carbohydrate, or part of it, depending on individual factors such as body weight of the patient, the severity of his diabetes, and the degree of his physical labor A program which has proved satisfactory for those patients engaged in industry is as follows

Midmorning		CARB	PROTEIN	FAT
½ sandwich				
Bread	30 grams	18	3	0
Butter	5 grams	0	0	4
Meat	30 grams	0	8	5
Coffee (if desired)				
Noon				
1½ sandwiches				
Bread	90 grams	54	9	0
Meat	60 grams	0	16	10
Cheese	30 grams	0	8	11
Butter	10 grams	0	0	8
Suitable vegetables such as celery, tomato				
Tea, coffee, or broth				
		72	44	38

If the patient eats breakfast after 7 00 A M, and/or does not have a truly laborious occupation, the midmorning lunch could be reduced to 10 grams of carbohydrate, and the extra protein and fat added at noon or not in-

cluded if the physician decided it to be unnecessary If fruit is taken at breakfast and at dinner, it may be omitted at lunch Should the patient desire fruit for his lunch, this can be arranged by omitting one slice of bread Five per cent vegetables may be added for bulk and appetite satisfaction The latter factor frequently determines how the carbohydrate is to be arranged For example, women may prefer fruit, and men the added slice of bread

SPECIAL DIETS

LIQUID DIABETIC DIET

Circumstances occasionally arise which call for a liquid diet The primary reason is exodontia, and less frequently, sore throats In the presence of these complications, the patient may need less protein and fat, but the carbohydrate intake should be that amount normally contained in the diet since the patient is usually instructed not to omit his protamine insulin at such times If the patient is too ill to drink or retain liquid foods, he should be hospitalized to permit the parenteral administration of carbohydrate When the diabetic is on a liquid diet, he should be instructed to take some food every two hours throughout the day until midnight, and then a final feeding at 4 00 A M A suitable diet for a twenty-four hour period would be as follows

	AMOUNT	CARB	PROTEIN	FAT
Milk	960 cc (1 quart)	48	32	32
Orange juice	480 cc (1 pint)	48	0	0
Ginger ale	480 cc (1 pint)	48	0	0
Oatmeal	240 grams (1 cup)	20	5	2
Eggs	3	0	18	18
		164	55	52
The addition of another pint of milk would increase the totals to		24	16	16
		188	71	68

From such a list of foods, the patient could prepare eggnogs, custard, oatmeal gruel, or ginger ale milkshakes should he prefer them to the simpler forms of food Since a small serving of ice cream (50 grams) contains 10 grams of carbohydrate, such a serving could be used by omitting 100 cc of orange juice or ginger ale (½ glass)

SOFT DIET

Should the patient have a severe upper respiratory infection, or any condition which might produce constitutional symptoms, his regular diet might be distasteful to him because of its bulk in the form of vegetables and meat A soft diet, fairly concentrated, would then be indicated The use of such a diet is usually of short duration, rarely more than a day or two The following is an example

Breakfast	AMOUNT	CARB	PROTEIN	FAT
Orange juice	100 cc (½ glass)	10	0	0
Egg	1	0	6	6
Bread	30 grams (1 slice)	18	3	0
Butter	10 grams (2 teaspoons)	0	0	8
Dinner				
Toast	60 grams (2 slices)	36	6	0
Butter	10 grams (2 teaspoons)	0	0	8
Prunes	75 grams (4 to 5)	15	0	0
Supper				
Cornflakes	15 grams (½ cup)	10	3	0
Eggs	2	0	12	12
Bread	30 grams (1 slice)	18	3	0
Bedtime				
Saltines	4	10	1	1
Milk	960 grams (1 quart)	48	32	32
(During day for cereal tea, etc)				
		165	66	67

WEIGHT REDUCING DIETS

The nurse may be surprised to observe that the physician prescribes a diet containing 1600 to 1800 calories rather than one of 800 to 1200 calories for an overweight diabetic However, the rationale behind such a prescription is understandable, for one may assume that when an individual presents himself with a body weight which is 30 to 70 pounds in excess of normal, his diet for months or years must have contained at least 4000 calories a day, in all probability more Thus, he will surely lose weight on a diet which is cut to less than half his usual intake A slow loss, perhaps 4 pounds each month, is desirable and adequate One must realize that most obese people enjoy food If the diet of an obese person is curtailed too drastically, he frequently becomes depressed and discouraged Such a mental state may eventually lead to the complete disregard of a quantitatively or qualitatively restricted diet, which in turn leads to uncontrolled diabetes as well as maintained obesity If the patient really wants to go on a weight reducing diet, the calories may be restricted to definitely lower levels than 1600, but most patients in the age group concerned have been obese for so many years that they themselves are not concerned for reason of personal appearance In fact, these patients usually feel that they are doing the doctor a favor when they agree to follow a weight reducing diet The nurse will do well to stress this trend by expressing her enthusiasm and pleasure when the patient loses weight Patients who are on reducing diets should be advised to restrict their use of table salt since salt holds back fluid in the tissues, and the retained fluid may disguise a loss of actual poundage Usually, the lower the caloric value of the diet, the greater is the salt intake because the patient uses leafy vegetables to "fill

up," and these vegetables are usually salted Diabetics, as a rule, have a greater salt intake than do nondiabetics because increased amounts are used to flavor foods which were formerly dressed with butter, gravy, sugar, or oil

TEACHING THE DIABETIC PATIENT

The patient should be instructed not only concerning the qualitative and quantitative restrictions of his diet, but also concerning the component parts of diet and the functions of food The instruction must be simple, positive, and within the experience of the individual The teaching nurse should constantly bear in mind that instruction of those patients with the least formal education represents the real test of her teaching ability If she can teach these patients adequately, there is no doubt but that she can teach diabetic patients in general

The idea of comparing the body to a machine is an old one, entirely lacking in novelty, but it is still satisfactory Elaborating on this simile, an explanation in the following vein is comprehensive to most patients Thus, every machine has at least two requirements energy or power to make it go and a provision for the replacement of parts used in functioning An electric washing machine has energy supplied by electricity which is measured in kilowatts The body, too, requires energy or power, which it receives from the food eaten However, this energy is measured in calories rather than in kilowatts A machine which is in constant use will require replacement for the parts which wear out The body, since it is in constant use even during sleep, needs constant replacement of cells or tissue building elements These elements are obtained through foods which the individual eats

The next step would be an explanation of the terms

CARBOHYDRATE	PROTEIN	FAT	LITTLE OR NO FOOD VALUE
Sugar and Starch	Animal Foods	Vegetable and Animal	For Bulk and Attractiveness
For energy (or calories)	For tissue repair and multiplication of tissue cells	For calories	May be taken freely by the diabetic
Fruits Cereals Bread Crackers Vegetables Potato	Meat Fish Egg Chicken Cottage cheese	Bacon Cream Butter Oil Mayonnaise Shortening Cream cheese Margarine	Clear coffee Clear tea Clear soups Vinegar Salt Pepper 5% Vegetables

Fig 13 Classification of foods

carbohydrate, protein, and fat One simple way to do this teaching would be to rule off a page in the patient's notebook so that the page resembles Figure 13 The nurse should elaborate adequately on the oral discussion of carbohydrates, proteins, and fats, but the charted explanation should be simple and concise The patient could be questioned, item by item, concerning the food which he has eaten for the past three meals Thus he will apply his everyday background as the basis for his newer terminology The nurse, to help him coordinate the application of new facts to known circumstances, questions the patient as to whether he thinks each item of food is a carbohydrate, a protein, or a fat

The next step would be that of discussing the patient's likes and dislikes in regard to food These and other expressions of opinion allow the patient to have an active participation in the planning of his own diet A diet which the patient helps to plan is less foreign to him than one which is prepared without his assistance

If the diet is written on a form like that of Figure 10 special menus are not necessary The nurse points out to the patient that special foods or special cooking is not required Instead, after pastry and actual sugar are omitted, he shares—in accurately defined amounts—the usual food eaten by his family

When the patient has been adequately instructed in regard to his basic diet, the approximate food substitutes may be discussed The patient must have a realization of the fact that he 'robs Peter to pay Paul," and that he must substitute "like for like" Experience reveals that the following list of factors must be stressed by the teaching nurse in regard to diet

1 Liquid foods do have food value Many patients report by telephone to the clinic that they are unable to

take food Questioning reveals that they are able to drink orange juice, ginger ale, or milk

2 Most of the commercial diabetic foods do have food value Therefore, they should not be used unless their food value has been determined, and correct subtractions made from the usual diet to permit their inclusion

3 Protein and fat cannot be taken freely merely because they do not contain carbohydrate in their edible states

4 No food should be substituted for milk since no other food will supply sufficient calcium

5 The diet should not be increased by the patient himself The diet is a prescription and only the physician may change it The physician might increase the diet if the patient were both underweight and sugar-free If the patient were underweight but not sugar-free, an increase in the insulin dose might be indicated rather than an increase in the dietary However, if the patient were overweight and sugar-free, the physician might decrease he insulin dose, but not increase the dietary Thus, the actual presence of the hunger symptom does not always mean that the dietary itself must be increased, for the nurse will recall that hunger is associated with either an extremely high blood sugar or with an extremely low blood sugar

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VII

DIABETIC COMA

Diabetic coma presents one of the most fascinating, dramatic, yet thoroughly discouraging episodes in the panorama of medical emergencies Known also at ketosis, acidosis, and acid poisoning, diabetic coma is fascinating because of the metabolic intrigue which is represents, dramatic because in a matter of hours the picture shifts from that of a patient who is critically ill and seemingly moribund with blood pressure and temperature at shock levels to one in which the patient is conscious and cooperative when therapy is timely and correct, discouraging because coma, which is entirely preventable in the known diabetic, represents a break in the continuity of an established treatment

PHYSIOLOGY OF ACID-BASE BALANCE

Normally, the hydrogen ion concentration of the blood is maintained by the buffer system in a slightly alkaline state, *p*H 7 35 to 7 45 The maintenance of this *p*H is essential to life, and it is achieved and maintained primarily by means of the eliminating mechanisms of the lungs and kidneys The usual dietary intake contains enough basic radical to neutralize adequately about half of the acid end products of digestion, and the base reserve or the fixed base of the plasma neutralizes the remainder Carbonic acid, the production of which far exceeds that of other metabolic acids, is reduced to carbon dioxide

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and water vapor which are readily excreted by the lungs, the kidneys eliminate phosphoric and sulphuric radicals as ammonium salts after first separating the base radical from the acid radical The acid radical then combines with ammonia which is synthesized in the renal tubules, and the base radical is restored to the body to form fixed base The renal tubules also assist in maintaining fixed base by transforming the somewhat alkaline filtrate of the glomeruli into an acid urine Acid bodies are excreted in free form in the urine By this second mechanism, still more base is restored to the blood If the glomeruli of the kidneys were unable to function adequately so that sodium salts rather than ammonium salts were excreted (extensive glomerulonephritis), or if the liver were to produce ketones at such an overwhelming rate that even normal kidneys could not cope with the situation (un controlled diabetes), then clinical acidosis would result

PHYSIOLOGY OF DIABETIC ACIDOSIS

Metabolically speaking, diabetic acidosis represents an imbalance of the acid-base buffer mechanism of the body Until recently, the theory was held that "fats burn in the fire of carbohydrates" Although such a theory is no longer supported, so universal was its acceptance that diabetic diets were planned with specific carbohydrate-fat ratios Newer theories state that carbohydrate does influence the oxidation of fat, but not in a mutual or a paired action Instead, carbohydrate is now recognized as the prime fuel for muscle needs, and the adequate presence of carbohydrate prevents the breakdown of stored fat Thus, carbohydrate is essential for a fat sparing action since the body will use fat for emergency purposes if the quantity of glycogen is deficient

Since the discovery of insulin, diabetic coma is no

longer the outstanding complication, but it is rather the unique complication of uncontrolled diabetes When his diabetes is uncontrolled, the diabetic's imbalance is recognized clinically by the symptoms of polydipsia, polyuria, and polyphagia, chemically by excessive blood sugar levels, and by the appearance of glycosuria These positive findings indicate that the diabetic patient is not metabolizing the carbohydrate of his diet because of a relative deficiency of insulin without which the forma-

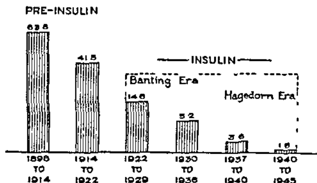


Fig 14 Percentage comparison of deaths due to coma in the pre insulin and insulin eras (Adapted from Joslin's Diabetic Manual, Lea & Febiger, Phila., Experience of George F Baker Clinic, New England Deaconess Hospital)

tion of glycogen becomes impossible When glycogen is not produced, the muscles are deprived of their main source of energy The diabetic's glycogen-depleted liver, in an effort to supply the body's needs, attempts compensation by the breakdown of stored fat to the stage of fatty acids or ketones These ketones (acetone, diacetic acid, and beta-hydroxy-butyric acid) are the intermediary products of fat metabolism Eventually, if the diabetic state were to remain uncontrolled, the rate of

ketogenesis would exceed the rate at which absorption could take place, so that acidosis would then develop In the normal pattern of digestion, fats are metabolized to carbonic acid, which is carried by the blood to the lungs and excreted as carbon dioxide and water ($H_2CO_3 \rightarrow H_2O + CO_2$) but in acidosis metabolism of fat does not reach the stage of carbonic acid Instead, the excessive number of ketones produced draw on the body's supply of fixed base, displacing the sodium bicarbonate of the blood plasma A stage is reached, eventually, when the plasma is wholly depleted of base reserve although the production of ketones continues without formation of carbonic acid During this phase, there is an increased amount of carbon dioxide in the tissues, because the metabollic shift to acidosis prevents its transportation to the plasma Thus, the fall of carbon dioxide combining power of the plasma indicates acidosis Analyzing the plasma for its carbon dioxide content is an indirect, although a rapid, simple, and reliable way to determine whether the body is in acid base balance, acidosis, or alkalosis The respiratory center of the brain, which is sensitive to the presence of an increased amount of carbon dioxide in the tissues, produces a type of air hunger known as Kussmaul respiration Kussmaul respiration, found in no other condition except extreme acidosis, is described as labored, unlike other types of labored breathing, the respirations are not rapid or shallow, but moderately spaced with inspirations and expirations of equal length

DIAGNOSIS OF COMA

At some clinics, the diagnosis of diabetic coma is established when the carbon dioxide combining power of the blood falls from its normal level of 50 to 70 volumes per cent to a low level of 25 volumes per cent However, a

finding of twenty volumes per cent is more widely used as a criterion of diabetic coma Thus, the diagnosis of diabetic coma is not established on the clinical findings such as drowsiness, stupor, and other mental states The diagnosis is based on chemical findings Such an arbitrary figure as a carbon dioxide combining power of twenty to twenty five volumes per cent is used because in the pre insulin era a patient with these levels usually lapsed into a state of unconsciousness which was followed by death

The procedure of blood studies calls for the services of trained laboratory technicians, but the urine test for diacetic acid is simple to perform and to interpret The procedure is as follows

1 Place 5 cc of urine in a test tube
2 Add about 15 drops of 10% ferric chloride If a precipitate forms, more ferric chloride should be added

If the mixture retains the yellow color of ferric chloride, no diacetic acid is present, if a wine red color develops, diacetic acid may be present, or the patient may have taken aspirin or salicylate To differentiate between diacetic acid and drug reaction, divide the contents of the tube by pouring half the mixture into a second test tube One tube with its contents is reserved for control, and the other is heated in a boiling water bath Diacetic acid is volatile, therefore, if the boiled specimen is lighter in color than the control, diacetic acid is present, if the boiled specimen remains a wine red in color, the change is referred to as a drug reaction which is of no significance

CAUSES OF COMA

To appreciate more fully the need for better education of the diabetic patient, the following summary is

submitted It is based on the admission of sixty-four patients with coma to the Hartford Hospital Several of these patients were admitted more than once

TABLE 11

CAUSE OF COMA IN 64 PATIENTS

	NUMBER OF PATIENTS	PER CENT
Omission of insulin	19	29 7
Omission of diet	22	34 3
Diabetes diagnosed during coma	9	13 9
Cause not determined	14	21 9
Deaths in coma	10	15 6

There were but two cases of coma which occurred within the first year of diagnosis in this series The latter finding could be interpreted as an indication that the diabetic tends to consider his disease seriously and conscientiously at the start of treatment, but that as time passes the novelty wears off, and the patient becomes careless It is impressive that omission of either diet or insulin was the etiological factor in approximately 65 per cent of all the comas in this series, and of approximately 73 per cent in the known diabetics The obvious conclusion is that the diabetic patient must be taught that the most effective way to avoid coma is by the establishment of routine checkups with his physician

DIETARY INDISCRETION

Many patients take insulin faithfully, but they do not follow a diet These patients may live for months or years with little or no inconvenience to themselves until an infection occurs In the coma series cited, although 22 of the patients had not omitted insulin, they did give a history of diet-breaking and general carelessness as etiological factors, however, 18 of these 22 patients had their comas precipitated by acute infections Thus, the

careless diabetic has a Damoclean sword over his head, for the development of even minor infections may cause him to become dangerously ill Here again is an example which stresses the patient's need of instruction to appreciate his disease and to respect its limitations

INSULIN OMISSION

Insulin is frequently omitted inadvertently even by conscientious patients when they experience nausea, vomiting, or anorexia The rationale of their decision sounds logical on first consideration, because insulin helps to digest food, when they are unable to eat or retain food, they then conclude that there is no need to take insulin Experience reveals that the omission of insulin during such an interval is now the commonest cause of coma Efforts should be doubled to teach all patients that even when they do not eat food, they still require insulin because the body consumes its own tissues Thus, since insulin is essential to the metabolism of food, whether the food comes from the diet eaten or from the body stores, insulin should never be omitted as an emergency procedure The dose of insulin may be reduced, but it should never be omitted without careful and painstaking study and observation

ACUTE INFECTION

During active infection, particularly with fever, mild acidosis may be present as indicated by a trace of diacetic acid in the urine, or by a carbon dioxide combining power of 35 to 45 volumes per cent If insulin is omitted at this stage, marked acidosis or coma could easily follow [illegible]

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start of acidosis, the patient is extremely thirsty, and his fluid intake dilutes the urine so markedly that the Benedict test rarely shows a red reaction If insulin is withheld entirely, the thirst becomes more intense, and lost in the large volume of urine voided are carbohydrates, chlorides, electrolytes, and ketone bodies with base radicals attached The ensuing dehydration results in a greatly lessened volume of circulating blood which in turn impairs heart action The cardiac and respiratory functions are further embarrassed by dilatation of the stomach with consequent nausea, vomiting, and abdominal pain

Pronounced dehydration, the total result of vomiting and polyuria, occurs when the acidosis is marked enough to be diagnosed as coma During the beginning stages the patient may be mentally alert As the acid intoxication increases, the patient gradually grows more drowsy and stuporous, until a state of profound coma may result Patients are admitted to the hospital in the different stages, but generally one may describe the acidotic diabetic as a patient whose dry, cold skin, hollowed cheeks, and sunken eyes manifest his extreme dehydration His skin may be flushed or pale, his lips are a characteristic cherry red color, and sordes are found on the lips, teeth, and gums The patient's breathing is labored often audibly and visibly, so that he repeatedly asks for air The odor of acetone is striking, and it is usually described as sweet and heavy The patient may be mentally alert, drowsy, stuporous, or comatose.

TREATMENT OF COMA

When coma has been diagnosed or suspected, the patient should be hospitalized because he needs supportive care as well as the benefit of blood chemistries

so that his condition may be evaluated and his treatment determined Urinalysis is not always reliable For example, urine tests are sometimes negative for sugar, and yet the content of sugar in the blood is markedly increased Such an occurrence is dreaded for it usually denotes renal failure, the leading cause of death in acid poisoning

INSULIN

Since coma represents an acute deficiency of insulin, the successful treatment of coma depends largely upon the prompt administration of what are termed "courageous" amounts of insulin Three-hundred units of insulin given within the first three hours of treatment is of more therapeutic value in saving the patient's life than the same dosage would be if it were scattered over twenty-four hours

FLUIDS

Isotonic solution of sodium chloride is given intravenously or subcutaneously to combat the loss of chloride, fluid, and electrolytes An average requirement is 4000 cc, but occasionally a need for even more is indicated

GLUCOSE

When the blood sugar falls to a level of 200 milligrams, glucose may be added to the saline, or carbohydrate may br given orally Dr Howard Root does not believe that glucose should be added until the blood sugar has fallen to this level because there is such an excessive supply of glucose already in the blood and tissues which could be converted into glycogen if sufficient insulin were given By reestablishing the oxidation of carbohydrate in this way, excessive ketone formation would

be curbed Whether glucose should be given initially, or given after the fall in blood sugar is still a moot question Although patients treated by both methods have survived, the death rate from coma is lower at the George F Baker Clinic in Boston (where Dr Root is a staff physician) than that of any other clinic which has reported At this clinic, the Joslin group feels that there is no proof that glucose given intravenously is superior to that glucose which is already flooding the patient's own tissues Dr Root further states that diabetic coma is not caused by a deficiency of glucose, but of insulin, therefore, insulin not glucose, is indicated

ALKALIES

Another debatable question concerning the treatment of coma centers about the administration of alkalies Owen's group reported a series of diabetic comas in which some of the patients were treated with alkali therapy, while a control group was treated without alkali therapy In the treated group, the urinary excretion of ketones was lessened, but there was a concomitant increase in blood ketones Those patients who received treatment with alkali were relieved of their Kussmaul respirations, and the rise in their carbon dioxide combining power was more than twice as great as that of the untreated group This rise in carbon dioxide combining power, however, did not cause an improvement in the mental condition of the patients, or an increase in blood pressure The authors concluded that alkalies have no antiketogenic effect in diabetic coma Dr Root further stresses that the diabetic may still die of coma if the carbon dioxide is raised to normal levels by the use of alkalies rather than by a true reversal of metabolic processes to their normal state

SUPPORTIVE TREATMENT

Since gastric dilatation is the rule rather then the exception, expression of the gastric contents relieves the patient of much discomfort, and paves the way for retention of oral feedings The acidotic patient is always constipated because of his extreme dehydration A cleansing enema is usually prescribed to relieve abdominal distention and to promote intestinal tone

The supportive shock treatment is carried out according to the individual hospital routine

TEACHING THE DIABETIC HOW TO PREVENT COMA

CRITERIA FOR CONTROL

That the prevention of diabetic coma is a teaching problem has already been stressed, for although coma itself is a critical emergency which requires hospitalization, the prevention of coma depends absolutely upon the education of the patient who must be taught, within his own scope of understanding, that there is no occasion which warrents the sudden omission of insulin, and that diabetic coma is a metabolic impossibility if the following guides for controlled diabetes are followed

1 Urine should be tested at least once daily The color reaction should be in the blue green color range

2 The fasting blood sugar level should be between 70 and 120 milligrams

3 The postprandial blood sugar should not exceed 160 milligrams

4 The body weight of patients under thirty years of age should be normal for their age and height, or slightly more than normal

5 The weight of patients who are more than thirty years of age should be at a level for thirty years, or slightly less, for the given height

ACUTE ILLNESS

When illness occurs, the patient may forget lengthy instructions To help him avoid coma, the nurse should write in the patient's notebook specific instructions concerning diet and insulin for use on sick days Most of these so called sick days are caused by what the patient calls "grippe" Such illnesses are usually of short duration, and most commonly accompanied by fever, anorexia, nausea, and vomiting Since most of these upsets seem to come on during the night, the patient is awakened with feeling of illness and prostration Before he contacts his physician by telephone, the patient should collect and test a specimen of urine and report the results of the test with other symptoms In the event that the patient is unable to contact his physician by telephone, he should have a specific outline of treatment to follow in order that he may prevent the development of acidosis Whether or not a temporary illness develops into coma depends largely upon how promptly prophylactic measures are started The nurse should confer with individual physicians to learn the routines which they desire their patients to follow The following instructions, adapted from those used at the New England Deaconess Hospital, are typical of the ones given to diabetics taught at Hartford Hospital The nurse should explain each step to the patient as she writes it in his notebook

If you awake feeling sick

1 Test your urine, or get somebody else to do it for you If the reaction is green or worse, take your usual dose of insulin, whether protamine insulin alone or protamine and crystalline insulin

2 Call your doctor

3 Test your urine again at 12 00 noon and at 6 00 P.M Take additional crystalline

insulin according to the color reaction as follows

Color reaction	blue	green	yellow	orange	red
Units of insulin (crystalline)	0	0	6	10	12

4 Test your urine at 10 00 P M , and take insulin as follows

Color reaction	blue	green	yellow	orange	red
Units of insulin (crystalline)	0	0	4	6	8

5 Take some food from the following list every two hours Make sure that the full quantity indicated is taken by bedtime If you feel nauseated, take the foods best tolerated (like oatmeal gruel or ginger ale) in sips As the nausea disappears, take water, tea, and salty broth in as large quantities as possible

		C	P	F
Ginger ale	1 pint	48	0	0
Orange juice	1 pint	48	0	0
Oatmeal	1 cup	20	5	2
Milk	1 quart	48	32	32
Eggs	2	0	12	12
Butter	1 teaspoon	0	0	4
Bread (toast)	1 slice	18	3	0
		182	52	50

In the schedule presented, the bedtime fractional doses are smaller because protamine insulin will be liberated slowly all through the night, although food will not be taken Frequently, the nausea disappears when the urine tests clear to blue or green If gastro intestinal symptoms persist for more than twelve hours, most doctors feel that the patient should be hospitalized in order that carbohydrates and fluid may be given as indicated by parenteral administration

TABLE 12

DIFFERENCE BETWEEN
DIABETIC COMA AND INSULIN REACTION

	DIABETIC COMA	INSULIN REACTION
I Cause	1 Not enough insulin 2 Too much food 3 Untreated infection	1 Too much insulin 2 Not enough food
II Onset	1 Gradual over a period of hours or days	1 Sudden in a matter of minutes
III Signs and Symptoms	1 Urine contains large amounts of sugar on repeated examinations	1 First urine sample tested may have sugar but second usually negative
	2 Thirst and frequency of urination	2 Hunger only
	3 Nausea always Vomiting usually	3 Occasionally nausea and/or vomiting
	4 Skin very dry	4 Skin damp to wet
	5 Pain in legs head and abdomen	5 Headache only
	6 Pulse rapid and weak	6 Pulse full and bounding
	7 Breathing labored	7 Breathing normal
	8 Extreme prostration with slowly developing stupor	8 Nervousness to rapid loss of consciousness
IV Treatment	1 Insulin	1 Carbohydrate in some form
	2 Fluids	
	3 Supportive shock treatment	

Some physicians request that their patients be instructed to reduce the usual dose of protamine insulin

by half during acute illness, and then larger fractional doses of crystalline insulin are prescribed at 12 00 noon and at 6 00 P M However, this practice seems less ideal, because the resumption of a normal routine is more slowly achieved Other physicians prescribe a carbohydrate intake which is greater by 15 to 20 grams than that one which the patient usually takes This addition is based on the fact that the diet used on sick days is composed mainly of liquid carbohydrate which is absorbed very quickly Therefore, an additional carbohydrate allowance toward evening would constitute a margin of safety in the event hypoglycemia developed as the patient's condition improved

Should the patient omit his morning dose of insulin during an active infection, coma would usually develop in a matter of hours rather than days Unlike insulin reaction which may occur in a matter of minutes, coma comes on slowly and insidiously over a period of hours, sometimes days The difference between diabetic coma and insulin reaction causes confusion at times The following chart brings out the ways in which they differ

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After hyalinization has occurred, the fatty plaques lose their original yellow color, becoming gray and pellucid Eventually, calcium salts are deposited in the hyalined areas in the plaques, making them hard and brittle Thus, the caliber of the vessel is narrowed because of the proliferative overgrowth of the intima which appears when the normal epithelium is replaced by the hyaline tissue and calcified plaques (Fig 15) To complicate the situation still more, these plaques frequently break down with a consequent ulcer formation Should the ulcer become infected, localized swelling would then occur, such a swelling would produce further narrowing of the vessel lumen, thus shutting off the blood supply even more Thrombosis, with resulting infarction, is another frequent finding because the brittle calcified plaques split and detach so readily

The larger muscular arteries, particularly those of the heart and lower extremities, are the ones involved In a series of 1489 consecutive diabetic admissions to the Hartford Hospital, 114 patients entered for foot complications, 149 entered for arteriosclerotic heart disease, and only 33 for cerebrovascular accidents

Since the atheromatous process is a gradual one, the attending occlusion is gradual also Frequently, as the occlusion progresses, there is a concomitant development of collateral circulation, a mechanism whereby the smaller vessels help to bear the onus of supplying circulatory needs

SIGNIFICANCE OF A PALPABLE DORSALIS PEDIS ARTERY

The absence or presence of the dorsalis pedis artery pulsation offers a simple and reliable way to determine whether or not there is occlusion of the main vessels which supply the feet with blood The dorsalis pedis, a

division of the anterior tibial artery, extends downward from the front of the ankle joint It supplies blood to the foot by anastomosing with branches from the posterior tibial artery Because the arteries run a somewhat devious course, the site of pulsation will differ from patient to patient, and since the diabetic's dorsalis pedis pulsation may be absent, the nurse should learn to palpate it in a nondiabetic foot before she attempts to find it in a diabetic foot

To find the dorsalis pedis, the nurse should place the thumb of her examining hand on the sole of the patient's foot Then, slight pressure should be applied along the site of the dorsalis pedis with the second, third, and fourth fingers until pulsation is felt To eliminate the possibility that the nurse is palpating her own radial pulsation rather than that of the patient's dorsalis pedis, pressure from the thumb of her free hand should be applied to the radial artery of her examining hand, this action will obliterate her own pulsation If the diabetic's foot is cold and pulseless, the outlook is precarious, for he then lives in the shadow of impending gangrene If the foot is pulseless but warm, a collateral circulation has been established The pulse rate of the dorsalis pedis is of no particular consequence, merely the absence or presence of pulsation is significant

SIGNS AND SYMPTOMS OF OBLITERATION

Pain is the most outstanding single symptom of occlusion At the beginning of the process, when the lumen of the artery starts to narrow, there is a consequent diminution of the blood supply to all the tissues involved, and localized malnutrition occurs During this period of circulatory diminution, the patient usually experiences

pain in the lower extremities which is termed intermittent claudication, intermittent meaning *between* and claudication meaning *lameness* The patient with intermittent claudication experiences severe, diffuse pain which involves, unilaterally or bilaterally, his foot, calf, and thigh after he walks or stands for relatively short periods, the pain disappears when he rests, but it occurs intermittently when he resumes his walking or standing This syndrome represents a stage in which the circulation may be inadequate for even limited physical activity, the larger vessels are in various stages of partial or complete occlusion, and the smaller vessels have not yet developed sufficiently to adapt themselves to their new function, that of supplying a collateral circulation The patient may go through this stage safely provided he does not develop a lesion of the foot which calls for the provision of extra circulatory or nutritional supplies Barring such lesion, the combination of collateral circulation and the blood supply derived from partially occluded arteries will be adequate for controlled physical activity However, should there occur a situation which requires healing such as a break in the continuity of the skin, this pooled blood supply might not prove sufficiently adequate to maintain the life of the tissues involved, gangrene would then occur

Because the deficient blood supply results in actual starvation of the tissue, muscle atrophy and lipodystrophy are usually pronounced, the skin of the extremities is thin, shiny, dry, and of cadaveric appearance, the toenails are thick and horny When the feet are elevated, they become wax like in appearance, when suspended, they turn dusty red in color These two changes indicate a circulatory impediment

PREVENTION OF ARTERIOSCLEROSIS OBLITERANS

Control of the diabetic condition, which means constancy in the maintenance of essentially normal blood sugar and blood cholesterol levels, is believed to be necessary for the avoidance of atherosclerosis since abnormal carbohydrate and fat metabolism seem to play such important roles in the diabetic setting Warren believes that because fluctuations in the concentration of blood sugar produce changes in the osmotic pressure, these fluctuations would result in an increased permeability of the arterial intima with swelling of the intimal ground-substance Sometimes the percentage of cholesterol is so increased in the blood plasma of those diabetic patients who are poorly controlled, or of those patients who live on diets which contain excessive amounts of fat, that the plasma is described as being creamy in appearance When such cholesterol-laden plasma enters an arterial wall which is characterized by increased permeability, the fat particles are believed to become imbedded in the abnormally loose ground-substance of the intima, as the process repeats itself over a period of time, atheromatous or fatty plaques are formed Whether or not the carbohydrate-fat ratio of the diets is of etiological significance in producing atherosclerosis is a moot question Most authorities believe that the carbohydrate fat ratio of diabetic diets should approximate that of the diet of normalcy

PREVENTION OF GANGRENE IN DIABETIC PATIENTS

To create an effective patient-teaching program directed toward the prevention of gangrene, the nurse must appreciate two facts first, that although 85 per cent of diabetic patients who develop gangrene are fifty-five years of age or over, those patients in the younger

age groups of the third and fourth decades must be taught thoroughly and aggressively, for they really represent the best cross-section for prophylactic teaching, second, the nurse must appreciate the fact that arteriosclerosis is rarely localized in one branch of the vascular system Therefore, the nurse would be wise to base her teaching on the assumption that the diabetic who already has marked arteriosclerotic involvement of his leg vessels would also have some degree of arteriosclerotic involvement of his cerebral vessels Inadequate circulation to the brain does not necessarily mean impairment of intelligence, but it does interfere with memory for recent events or newly acquired knowledge Thus, when the patient is elderly, teaching must include the patient's family as well as the patient himself For the instruction concerning care of the feet, the teaching nurse should attempt to plan on the presence of several members of the patient's family Should only one person be instructed, that person might leave home eventually because of marriage, business, ill health, or other reasons, and the patient would then be left to his own inadequate resources, or the one person instructed might sacrifice his own plans to care for the diabetic

CAUSES OF GANGRENE

Although an obliterating, intimal atherosclerosis is the primary cause of gangrene in the lower extremities of diabetics who have had the disease for more than eight years, the precipitating factor is usually infection or trauma Since infection and trauma are largely avoidable, then typical diabetic gangrene is avoidable through a teaching program which becomes effective during the initial instruction period of all newly diagnosed adult patients

ROUTINE CARE OF THE FEET TO PREVENT GANGRENE

Daily Bathing of the Feet Too frequently the nurse assumes that all individuals take daily baths, and that daily bathing of the feet is thus accomplished However, there are several reasons why elderly patients, in particular, do not have a tub or shower bath daily Many of them come from homes where the facilities are not available Again, all houses do not have heating plants, and under such circumstances, complete baths require fortitude of nature in cold weather Because of age and actual infirmity, other patients feel that the taking of a tub bath is hazardous Therefore, although daily baths and personal cleanliness are desirable, one must face the reality of the situation by stressing the need for a daily foot bath Those people who have always taken a daily bath will continue to do so, but those to whom a daily bath involves more detail than the mere filling of a tub would observe only those health programs which are within their limitations The nurse must take pains to stress that bathing the feet does not mean soaking them The latter procédure itself might prove hazardous if it were employed oftener than once or twice a week

For daily bathing, the patient should be instructed to use water which is lukewarm or tepid Nothing should be added to the water except soap The patient with poor circulation usually has poor tactile sensation, his feet may become burned to an alarming degree without his being aware of the fact Yet, because his feet are cold and uncomfortable from deficient circulation he is tempted all the more to take a hot foot bath to relieve his discomfort To add table salt (sodium chloride) or Epsom salts (magnesium sulfate) would be dangerous for a diabetic since these substances are not only drying to the skin when they are applied locally, but they may

produce maceration Patients with circulatory deficiency of the extremities usually have skin which is so dry and scaling that softening agents are a necessity Because of the fragile, parchment-like skin, these patients must be taught to use a drying towel gently, blotting the skin dry with pressure rather than with vigorous rubbing This is of particular importance for the areas between the toes where excessive moisture accumulates because of the pressure contact of two skin surfaces

Skin-softening Agents Except for the areas between the toes, the skin of the feet is usually dry and chapped unless lubricating applications are used routinely For this purpose, lanolin, cocoa butter, olive oil, petrolatum, or any good hand cream is satisfactory Animal fats like lanolin, however, seem to be more satisfactory than vegetable or mineral fats, hand creams and cold creams which contain lanolin are not so effective as the concentrated lanolin, which must be rubbed into the skin The massage required for adequate absorption of the unrefined lanolin may contribute to the good results achieved with it Patients should be shown how to apply lanolin correctly The common fault is to apply it so generously that the bed linen becomes soiled and the patient's feet feel damp and uncomfortable Since the patient may discontinue the use of lanolin for these reasons, he should be taught to apply the lubricant sparingly The nurse should stress that except for the spaces between the toes, all parts of the feet including the nail, cuticle, and the area at the back of the heel over the Achilles tendon, require the application of lanolin In cold seasons, patients may require the applications daily, in warm weather, every other day or twice weekly Without lubrication, the skin of the feet becomes excessively dry so that chapping and fissures occur, thus constituting a

break in the continuity of the skin The healing of such lesions is not only an extra burden to the inadequate circulation, but the open spot itself is a portal of entry for the organisms of infection

Daily bathing and lanolin therapy will also help to keep the diabetic foot-conscious He will thus *see* skin lesions which his hyposensitivity would not enable him to suspect Should there be an unknown break in the skin which the patient neither sees nor feels, the daily bathing will help to lessen the incidence of infection or absorption of dye from hose

Diabetic patients at some hospitals and clinics are referred to interested chiropodists for routine foot care Earlier in the chapter, reference was made to the thickness and brittleness of toenails in the presence of circulatory deficiency Therefore, unless the patient has good vision, his nails should be trimmed by a chiropodist, or by a member of the family who has been instructed concerning the correct procedure People who are sixty years of age or older are rarely limber enough to be able to see all surfaces of their own feet In addition to this problem, the diabetic frequently must cope with another one, diminution of vision caused by lens opacities or retinopathies To complicate the situation further, elderly diabetics tend to have such high thresholds for foot pain that they may be wholly unaware of skin lesions which are serious enough to produce gangrene The obvious conclusion is that all older diabetics should have their feet examined carefully once a week by another member of the family Sunday is suggested as the examining day because it is usually a day of lessened or leisurely activity within the family group

Before nail cutting is attempted, the patient should soak his feet in warm, soapy water for fifteen minutes

However, the nurse must stress that soaking of the feet is reserved as a weekly event because daily soaking would cause the skin to become too soft and tender The nails should not be cut too short since they act as protectors for the toes The patient should be taught that sharp metal instruments such as nail files or scissors-points, should never be inserted under the nail for cleaning purposes, a blunt orangewood stick would serve this purpose more safely

Avoidance of Artificial Heat Since many diabetics have a relative insensitivity to pain and heat, the nurse will readily appreciate the danger of applying heat through the media of hot water bottles, electric heating pads, or heated bricks Beds may be preheated with these appliances, but the patient must understand that such appliances must be removed before he gets into the bed To surmount the pain and discomfort which some diabetics experience from cold feet, the nurse should emphasize the use of woolen bed socks and lightweight woolen blankets which may be wrapped around the legs and feet People who have always lived in the city may have to be instructed concerning the use of thin blankets rather than sheets in winter

Shoes No particular brand of shoe is prescribed, and the diabetic should be taught to look for certain qualifications rather than for a particular price level He must understand that a shoe which is too short or too narrow will further constrict the flow of blood to his feet, that a shoe which is too large or too long will cause undue friction with the possible danger of scraping off the skin, particularly that which covers the Achilles tendon, that the stitching found on shoes made with toe-box construction may produce pressure and constriction of the foot at its broadest part, which is popularly known as the

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bunion joint The shoes should not be made of stiff, unyielding material, but of a soft, pliant leather The patient must be taught to break in shoes slowly, wearing them for one hour only on the first day, the time may then be increased daily so that at the end of ten to fourteen days, the patient may be able to wear the shoes outside of his home The nurse should stress the danger of allowing the heels of shoes to wear down on one side for such a process distributes weight bearing incorrectly For instance, if the heels were permitted to wear down on the outer aspect, a corn would appear on the fourth toe as a result of the faulty mechanics

TREATMENT OF CORNS AND CALLOSITES

The rapidity with which calluses will develop on diabetic feet further emphasizes the need for routine chiropody The strongest point to stress in the teaching program concerning the treatment of corns and callos ities is that the diabetic must never self medicate or treat under any circumstances The patient and his family must realize that the use of commercially prepared and advertised foot remedies, as liquid and ad hesive corn plasters may cause the diabetic individual to lose a leg If the nurse will make a special issue of questioning diabetic amputees concerning their original lesions, she will be appalled at the number who will say that their foot complication started with a callus which was self medicated, or which was merely scaled out with their fingers

FIRST AID TREATMENT OF FOOT LESIONS

Diabetic patients should be instructed to see their physicians as soon as possible following an incident which produces erythema or a break in the skin which covers

any area of the legs or feet Seventy per cent alcohol or hexylresorcinol (S T 37) may be applied safely by means of sterile gauze, which should be kept on hand always Mercurochrome is safe to use, but it stains the lesion so inclusively that the physician might have difficulty in evaluating the situation Patients should be warned against the use of strong antiseptics such as iodine and cresol, as well as the use of hot soaks as emergency measures They should be advised to seek medical advice following the development of localized pain, heat, redness, or swelling since these are the classical symptoms of infection

FUNGUS INFECTIONS

Fungus infection of the feet, commonly referred to as "athlete's foot" by the layman, is really a symbiosis between fungi and bacteria With diabetics in particular, the condition is difficult if not impossible to clear The use of strong disinfectants is prohibited because they may produce a dermatitis, and elements of the fungus growth may reach the blood stream If a lesion, no matter how slight, appears between the toes, and does not clear up within two or three days when dusted with 10 per cent boric acid powder, the diabetic should consult his physician For the acute stages, some physicians prescribe an ointment prepared as follows

Tincture of metaphen	2 grams of each
Sulphur	
Salicylic acid	
Base (yellow petroleum jelly) 30 grams	

Later 10 per cent boric powder may be used between the toes as a dusting powder To avoid fungus infections, diabetics should be instructed not only to avoid walking

barefooted, but also to avoid the use of rubber soled shoes or of woolen hose with street shoes as well as any other factor which would encourage the formation of foot moisture

DAILY REST PERIODS

The physician will prescribe individually the activity limitations and rest periods for each patient The specific prescription or advice will depend upon the presence or absence of dorsalis pedis pulsations, intermittent claudication, and collateral circulation as well as on the patient's intelligence and occupation If the patient has had gangrene in the past, he will be advised not to stand on his feet for more than an hour at a time Many working patients, particularly men, are able to remove their shoes and elevate their feet during designated short rest periods as well as during lunch hour The patient with precarious circulation of his feet is the only diabetic who may have to change his occupation, but since most patients with this condition are in the older age brackets, the picture is not so alarming as it might appear on first analysis

DEVELOPMENT OF COLLATERAL CIRCULATION

Since atherosclerosis is not a reversible condition, vasodilators are of no value in relieving the patient's pain, and habit-forming drugs are not prescribed for obvious reasons Remissions from pain will occur if the collateral circulation is developed spontaneously or with the assistance of postural exercises Modifications of the well known Buerger's exercises are most commonly used for this purpose because they are simple to perform, require no special apparatus, and are surprisingly effective These exercises relieve pain in varying degrees, and

they also help to prevent gangrene The one contraindication for their use is active infection of the foot or leg The patient can be taught how to do Buerger's exercises at home or in the clinic since the apparatus consists only of a clock (or large watch with easily defined minute spacings) and a straight-backed chair The patient is first told to lie flat on a bed or couch with one pillow (or no pillow) under his head The chair is placed at the foot of the bed so that the chair-back provides a slanting runway on which the patient can elevate his legs The patient elevates his feet on the chair-back until blanching occurs, or for approximately two minutes Then, he sits on the edge of the bed and allows his feet to dangle until they turn a dusky red in color, or for approximately three minutes Finally, there is a rest period of five minutes, during which time the patient lies flat in bed with his legs on a level with his body These three positions constitute one cycle, the patient is usually instructed to complete six cycles in the morning, afternoon and evening If the patient has difficulty in counting the minutes on a timepiece because of poor vision, the nurse could teach him how to time his cycles with a three-minute sand-glass such as a housewife uses to time the boiling of eggs A strip of adhesive tape may be pasted on the glass at the levels reached in two minutes The patient should be given written instructions, which might be as follows

1 Elevate your legs on the chair back until sand reaches adhesive strip (In the process of shifting positions, the third minute elapses)

2 Hang your feet over the edge of the bed for three minutes, or until all the sand passes from the upper glass to the lower

3 Lie flat in bed for six minutes or while the sand passes through from the upper to the lower glass twice

INSTRUCTION FOR THE PATIENT'S NOTEBOOK

The following instructions concerning care of the feet were prepared by Dr Elliott P Joslin and printed by Thomas Groom and Company

Hygiene of the Feet

1 Wash feet daily with soap and lukewarm water Dry thoroughly, especially between toes, using pressure rather than vigorous rubbing
2 When thoroughly dry, rub with lanolin as often as necessary to keep skin soft and free from scales and dryness, but never render the feet tender If the feet become too soft, rub once a day with alcohol
3 If nails are brittle and dry, soften by soaking in warm water one half hour each night and apply lanolin generously under and about nails and bandage loosely Clean nails with orangewood sticks Cut the nails only in a good light and after a bath, when the feet are very clean Cut the nails straight across to avoid injury to the toes and do not cut the nails too short If you go to a chiropodist, tell him you have diabetes
4 All patients with overlapping toes or toes that are close together should separate them by lamb's wool Patients with large joints or cramped up toes should wear shoes without box toes and made of vici kid leather
5 All patients over 60 should have daily rest periods and remove their shoes Every Sunday morning ask someone to examine your feet
6 Do not wear bedroom slippers when you ought to wear shoes Slippers do not give proper support Do not step on floor with bare feet
7 Wear shoes of soft leather which fit and are not tight (neither narrow nor short) Wear new shoes ½ hour only on the first day, increasing 1 hour daily
8 Use bed socks instead of hot water bottles, bags, bricks, or electric heaters
9 After 50 years one hears less well, sees less well, and the sense of feeling is diminished Remember this and be cautious about the feet

Treatment of Corns and Callosities

1 Wear shoes which fit and cause no pressure
2 Soak foot in warm, not hot, soapy water Rub off with gauze or file off dead skin in or about callus or corn Do not tear it off Do not cut corns or callosities Do not try to remove corns or calluses with patent or with other medicines
3 Prevent calluses under ball of foot,
   (a) by exercises such as curling and stretching toes 20 times a day,
   (b) by finishing each step on the toes and not on the ball of the foot

Aids in Treatment of Imperfect Circulation, Cold Feet

1 Exercises Bend the foot down and up as far as it will go 6 times Describe a circle to the left with the foot 6 times and then to the right Repeat morning, noon, and night
2 Massage with lanolin or cocoa butter
3 Do not wear circular garters or sit with knees crossed
4 If you have had or been threatened with gangrene, keep off your feet 5 or more minutes each hour of the day and if an amputation, 15 or more minutes

Treatment of Abrasions of the Skin

1 Proper first-aid treatment is of the utmost importance even in apparently minor injuries Consult your physician immediately
2 Avoid strong irritating antiseptics, such as coal tar products and iodine
3 At once after injury some surgeons recommend applications of sterile gauze saturated with medicated alcohol or hexylresorcinol (S T 37) Keep wet for not more than 30 minutes by adding more of the antiseptic solution Sterile gauze in sealed packets may be purchased at drug stores
4 Elevate and, as much as possible until recovery, avoid using the foot
5 Consult your doctor for pain, redness, swelling, or any inflammation

GANGRENE AND AMPUTATION

Before the introduction of chemotherapy, septicemia was frequently the cause of death in diabetic patients who developed gangrene Buerger defined gangrene as the death of macroscopically visible portions of the body Amputation is then the only possible procedure The distribution and the degree of gangrene present do not determine the site of amputation For example, if a diabetic had a gangrenous toe, and a pulsating dorsalis pedis or a warm foot, a mere toe amputation might be a satisfactory procedure However, one gangrenous toe on a cold, pulseless foot would usually warrant a thigh amputation since the surgeon must operate at a level which is high enough to reach arteries capable of supplying ample blood for healing Lower-leg amputation is rarely performed on diabetic patients, for although this operation saves the knee joint and permits normal gait, the stump will not bear weight or pressure over long periods McKitterick feels that the procedure should be reserved for patients under sixty years of age whose occupations do not make it necessary for them to be on their feet for long periods At the present writing McKitterick has a series of diabetic patients upon whom he has performed transmetatarsal amputations Chemotherapy and modern surgery saved these patients from thigh amputation, and left them with functioning feet from the point-of-view of weight-bearing

TEACHING THE AMPUTEE HOW TO WALK

Patients with only toe amputations do not need walking instruction Patients who have had transmetatarsal amputations should be taught to stuff the empty portion of their shoes with lamb's wool, these patients may use a cane at first, but they do not require actual teaching

The patient who has had a thigh amputation usually starts walking with crutches on his twelfth postoperative day On the fourteenth day, he starts to use a pylon (peg leg) Frequently, the patient is discharged from the

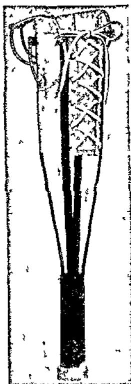


Fig 16 Walking pylon

hospital long before he has mastered the art of walking To the family and the visiting nurse goes the responsibility of teaching the patient how to walk Patients usually wear their pylons for the first six months At the end

of this period, shrinkage of the stump has occurred, and the patient is ready for his artificial leg Pylons are relatively inexpensive (about $45), their use preserves joint function and muscle tone during the waiting period, and eliminates the crutch habit by providing a weight-bearing substitute during the six month interval Because of inadequate vision, senility, feebleness, or the question of an impending amputation of the remaining leg, many amputees are maintained indefinitely with pylons As a factor in personal appearance, pylons are unsatisfactory because they do not have a foot-like part However, they do provide the essential weight-bearing appliance so that the patients do not become bedridden, but are ambulatory at least within the confines of their own homes Should the amputee be a person who eventually will wear an artificial leg, he may still retain his pylon indefinitely to use as a "slipper" for getting up during the night since the pylon is easier to apply than the artificial leg, or the pylon may be returned to the manufacturer of artificial limbs for partial payment toward the cost of the permanent prosthesis (Fig 16)

Younger amputees, those between fifty and sixty-five years of age, should be taught how to walk with prostheses, for unless they are prematurely senile they will live useful lives The will to become physically independent is essential for rehabilitation, it may have to be fostered, for a thigh amputation is mutilation from the psychic as well as the physical point of view The nurse will feel more justified in her insistence that these patients learn to walk, thus overcoming their psychic trauma, if she appreciates the fact that because of timely radical surgery they have been spared the ordeal of many months of costly hospitalization, bed confinement, and a series of surgical episodes which would lead to

radical surgery at the end By this time, the patient would have lost the physical stamina to use an artificial limb, and the finances to pay for one McKittrick aptly says that working on an artificial leg is more practical than nursing a useless foot Yet, the procedure of thigh amputation is carried out only after careful and deliberate weighing of all the evidence which each individual patient presents, for few diabetic patients do return to gainful occupations after they have undergone a radical amputation

Unless the patient has had bilateral leg amputations, the nurse should advise his family not to buy a wheel chair because the presence of a wheel chair eliminates the need for walking, and also carries the stigma of invalidism

Walking on a Pylon The patient slips into his pylon as he sits on the edge of the bed, but he does not adjust the shoulder straps until he is standing A lightweight chair, to serve as a walker, is more satisfactory than crutches since it eliminates the danger of falling The patient is instructed to place both hands on the chair back, he then pushes the chair ahead of him and steps after it Small scatter rugs and highly polished floors are obviously hazardous Initial instruction with crutches proceeds at a markedly slower rate Should crutches be used, however, the nurse should instruct the patient to consider the two crutches plus the pylon as one leg Counting aloud is essential At the first count, his own leg is placed forward, at the second count, he places the crutches forward and simultaneously swings his pylon Counting aloud helps to establish rhythmic sequence Since the process is tiring, both emotionally and physically, to the patient, the nurse should not attempt to keep him at practice for more than a few minutes In-

stead, some member of the family should observe the demonstration This provision would enable the patient to have several short periods of supervised practice daily until the time when he will have enough courage to walk alone The length of time required to master the art of walking will vary according to the personality, intelligence, and strength of the individual patient

The next step, following the walker or crutch instruction, consists of using canes Employing two canes, the patient first learns how to shift his weight from leg to pylon, this he should do several times before he attempts to take steps The nurse should instruct the patient to take short steps in order that he may eventually establish a more normal gait The patient always has a tendency to stride with the pylon For this reason, the patient should be instructed to take a longer stride with his normal leg, and then to bring the pylon up only to the toes of his foot

If the pylon tends to turn outward, the outer strapping should be made tighter than the inner one

The patient himself decides when he can walk with one cane Eventually, the more vigorous patients walk without mechanical supports like canes, but some patients, whether wearing pylons or artificial limbs, will always require canes

ARTIFICIAL LIMBS

There are three commonly used substances in the manufacture of artificial limbs These are wood, airplane metal and fiber, there is but little difference in the weight when the leg is completed Since metal is a conductor of heat, the person who works at an outdoor occupation might avoid wearing a leg constructed of metal Legs made of fiber or metal do not lend themselves readily

to alteration, yet shortening and lengthening are frequently necessary Although most manufacturers believe that an artificial leg of wood is to be preferred for the average patient, there are other manufacturers with impressive evidence supporting the desirability of the other two substances

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IX

OTHER COMPLICATIONS ASSOCIATED WITH DIABETES

Diminution of Vision, Gingivitis, Peripheral Neuritis, Nephritis

DIMINUTION OF VISION

DIMINUTION of vision or total loss of vision is one of the most disturbing complications associated with diabetes Until recently, partial or total blindness was believed to be an entity of middle-aged or elderly diabetics, but the longevous effect of insulin, which has enabled those diabetics with onset during childhood to reach youth and maturity, has proved that loss of visual acuity is not related to the chronological age, but rather to the chronological duration of the diabetes

RETINOPATHIES

The retina, which is the most essential constituent of the eye (Fig 17), is its most vulnerable part when the diabetes is of long duration The term retinitis should not be used to describe the usual retinal manifestations found in the diabetic since these manifestations are of degenerative rather than of inflammatory nature, retinopathy is a more correct descriptive term for the condition

The retina is described as a continuation or extension of the brain to which it is connected by the optic nerve The optic nerve is not a nerve in the usual conception

one stage or another, they are frequently the first step toward loss of central vision If the condition is diagnosed in the early stages, McKee believes that exacting observance of the diabetic routine tends to arrest their progress This desired constancy in the maintenance of normal blood sugar and cholesterol levels is sometimes difficult to achieve, especially when the disease has persisted for many years and the cumulative effect of anything but perfect control has become evident, thus, the condition usually tends to grow more extensive, out of proportion to the age of the individual, but in proportion to the duration of his disease Usually, the patient has temporary losses of central vision when fresh hemorrhages occur in the macula which are followed by remissions when—and if—the hemorrhages are absorbed

Although the specific etiology, outcome, and treatment are obscure, the nurse should be able to understand that shifts in blood sugar levels with a resulting osmotic interplay will increase the permeability and fragility of the blood vessels, particularly the capillaries Since retention of vision depends greatly on meticulous observation

which he does not have complications

Retinitis Proliferans This is the term applied to a degenerative condition in which there are massive hemorrhages which extend from the retina into the vitreous Bands of connective tissue form in an effort to control the proliferation of the massive hemorrhages When these bands of connective tissue contract, eventual detachment of the retina itself may follow Retinitis proliferans is progressive in its course, and immune to treatment

LENS OPACITIES (CATARACTS) AND ABNORMALITIES

Any opacity of the crystalline lens is referred to as a cataract Whether or not cataracts are seen more com monly in diabetics than in nondiabetics is a debatable question Some authorities state that the incidence of cataracts is not greater in diabetics, and that the term *diabetic cataract* is erroneous Others claim that many so called nondiabetic patients with cataracts would prove to be mild diabetics if they were more carefully evaluated Authorities who hold that the incidence is higher in diabetics offer for consideration the fact that rabbits with severe and long duration diabetes, produced by injection of alloxan, do develop lens opacities Since cataracts of endogenous type are usually associated with elderly patients, their presence may indicate merely the increased longevity of insulin treated diabetics

In talking with the patient, the nurse would be wise to avoid the term *cataract*, for the patient usually associates it with its most sinister outcome, loss of vision The condition, then, is better referred to as lens opacity or film in discussion with the patient

When the lens becomes opaque, the percentage of vision lost depends upon the extent and site of the opacity Successful extraction of the opaque lens and a subsequent replacement with a correct lens usually enables the patient to secure useful vision However, should the patient have an opacity of the lens superimposed upon retinopathies which involve the macula, as the diabetic frequently does, extraction of the lens will not restore his vision to the degree that would have been obtained if the retinopathy did not exist Should the diabetic have bilateral cataracts and bilateral retinopathy, the surgeon may decide to remove the lens from one eye, not with the thought of enabling the patient to see efficiently, but

rather with the hope of enabling the patient to get about by himself within certain surroundings

Blurring of Vision Temporary blurring of vision is frequently experienced by the diabetic patient during his initial stabilization period At any time after the third day of initial treatment with diet restriction and insulin, the patient may become apprehensive because of this blurred vision which leaves him unable to read printed matter The nurse should assure the patient that the blurring is of transient character, but that it may persist for days or weeks The nurse should also stress the fact that the patient should not seek advice concerning a change in glasses for at least six weeks The exact reason for this temporary blurring is not known Sansun believes it is caused by a change in the volume of fluid held in the tissue Before the diagnosis of diabetes has been made and treatment established, the patient is usually dehydrated from his polyuria The resulting deficiency of fluid from the lens gradually causes a change in its shape Then the rapidity with which the dehydration is corrected during the first twenty four to forty-eight hours of treatment produces a temporary handicap for the lens Root advises that alterations in the patient's glasses should be delayed until osmotic equilibrium between the lens and the ocular fluids is attained, a period which may take four weeks Occasionally, if the patient is really handicapped from a professional or economic point of view by his temporary blurring, and he feels that the expense of an extra pair of glasses is worth the investment, the physician may advise him to consult an oculist

GINGIVITIS

Gingivitis, or inflammation of the gums, is frequently seen in diabetic patients, although there is no particular

type of gingivitis which is pathognomonic for diabetes Erosions of the gum margins are fairly common in the fourth and fifth decades of life, but in diabetic surveys the incidence is high in all decades Such a finding undoubtedly is influenced by the fact that diabetics are predisposed to an excessive formation of tartar which is irritating to the gums and causes them to recede from the teeth Since healthy gums serve as a supportive framework for the teeth, untreated recession of the gums produces loosening of the teeth

The teeth, even in adult life, reflect environmental factors which start in early life The deciduous, or "baby," teeth begin to develop at about the fourth month of intra-uterine life, tissues formed during this period are seldom defective since the fetus is well provided with self-preservative fortifications From birth to the end of the first year, many physical irregularities, dietary deficiencies, and even minor variations of health produce grave disturbances in dental calcification Massler claims that 85 per cent of all tooth enamel hypoplasias occur during the first year of life During the period from two to six years, the teeth are more resistant to irregularities, since the major development factors occur before this time From the sixth year of life, dental calcification is completed in all teeth except the third molars Therefore, in the adult, teeth are completed structures which are no longer directly affected by dietary deficiency factors However, the gingivae, or gums, are particularly sensitive to metabolic irregularities and osmotic changes These factors are always present when diabetes is uncontrolled, for when the blood sugar is sufficiently elevated to produce polydipsia and polyuria, generalized dehydration with localized dryness of the oral mucous membrane is always present Saliva, which is about 99 5 per

cent water, cannot be produced in the required amount during dehydration As a result, the chlorides of carbonates and phosphates, normally found in the saliva, are present in a medium which is more concentrated than in normalcy, these chlorides combine with organic material to form tartar which is then deposited on the teeth in excessive amounts In addition, water-soluble vitamin C is lost when polyuria is present, this vitamin is an anti bleeding factor and its absence produces increased fragility of the blood vessels These circumstances alone could account for the high incidence of gingivitis in diabetic patients in whom typical symptoms such as excessive tartar formation on the teeth, tender gums which bleed readily, and eventual loosening of the teeth, are found In the earlier stages, this condition is frequently reversible if the diabetic cooperates with his physician and his dentist, otherwise, pockets of purulent material form underneath the gum line between the teeth When the formation of purulent material occurs, the condition is referred to as pyorrhea rather than gingivitis

PREVENTION

Since the dehydration which occurs as a result of high blood sugar or acidosis, and the vitamin C deficiency which occurs as the result of polyuria, are both important factors in the development of gingivitis, the nurse must stress again the need for carefully controlled diabetes Since tartar accumulates more readily on the teeth of diabetics, these patients should be instructed to see a dentist or dental hygienist for prophylactic treatment (removal of the gum-irritating tartar) as often as necessary, sometimes monthly visits are required, but three months constitutes the usual interval

The patient should be instructed to brush his teeth for three minutes at least twice during the day The brush should be a junior-sized one with tufts well separated The bristles should be genuine, not made of nylon, nylon bristles may produce punctate lesions of the gums when they are already tender, soft, or irritated The jaw angle is not roomy enough to permit efficient brushing of the last molars when the brush is a large one The nurse should instruct patients to have two toothbrushes which should then be used alternately, and retained for use only as long as their bristles remain firm The average toothbrush is rarely efficient for more than six to eight weeks

Many dentists recommend a dentifrice composed of equal parts of sodium bicarbonate and sodium chloride, if the patient desires a pleasanter tasting tooth powder, a small container of commercially prepared powdered dentifrice may be added The combination of sodium bicarbonate and sodium chloride acts as a good polishing agent, in addition, the salt helps to harden the gums, and the sodium bicarbonate neutralizes acid

The teeth and gums should not be brushed with an up and down motion since this type of manipulation with a toothbrush may cause traumatic bleeding of tender gums The upper teeth should be brushed from the gums downward, the lower teeth from the gums upward The patient must be taught to massage his gums after each brushing, for this, the thumb and fore finger are used in a mechanical rotating motion Massage increases the local blood supply and helps to harden the gum tissue

The planned diabetic diet usually contains food like oranges, grapefruit, bananas, potato, and cabbage which provide vitamin C in amounts considered super-minimal,

but if the diabetic exceeds his carbohydrate tolerance, he will develop an elevated blood sugar and ensuing symptoms of polydipsia and polyuria, and the water-soluble vitamin C will then be lost in the urinary output This factor presents another teaching point for the patient must understand that the adequate intake of vitamins does not guarantee adequate utilization of them

Should the gingivitis be so marked that loose teeth and painful gums prevent the intake of essential food substances like meat and vegetables, exodontia may be an inevitable outcome If refractive pyorrhea is present, exodontia offers the only solution because not only will dietary deficiencies occur, but the diabetic condition will become more severe in the presence of chronic infection All persons from the second decade on through life should have annual roentgenographic examinations, and the diabetic does not constitute an exception to this rule

NEURITIS

Peripheral neuritis, which is a distressing and relatively common complication of uncontrolled diabetes, is caused by a degeneration of the medullary sheath which acts as an insulator to the nerve fiber Peripheral neuritis occurs as the result of a deficiency in intake or absorption of thiamine (vitamin B_1) Thiamine cannot be synthesized within the body, nor can it be stored to any extent

There are three probable reasons for the marked incidence of neuritis among diabetic patients (1) Thiamine is definitely water-soluble, so it will be lost in the urine when polyuria is present because of an elevation of blood sugar (2) A high carbohydrate intake calls for an increased amount of the vitamin B complex, when the diabetic has a carbohydrate intake which is relatively

great in accordance with his impaired tolerance, he would show results of vitamin B deficiency (3) Free hydrochloric acid in the gastric contents is essential to the utilization of vitamin B, but after diabetes has been of ten or more years' duration, there is a marked inci dence of achlorhydria

SYMPTOMS OF PERIPHERAL NEURITIS

The patient's chief complaint is that of sharp, shooting pains which most commonly involve the arms, fingers, legs, or toes The most severe pain occurs at night and is severe enough to prevent sleep, it is usually replaced by paresthesias and numbness during the day Tingling occurs intermittently with the pain and numbness Although death never occurs as a result of neuritis or insomnia, the patient who suffers from these symptoms usually experiences mental depression which comes from the frustrating combination of chronic pain and lack of sleep

Another disturbing symptom which frequently accompanies the neuritis is diarrhea which may be diurnal, but is more frequently nocturnal in occurrence The diarrhea is sometimes so severe that the patient is incontinent

TREATMENT

Unlike the polyneuritis of pellagra or alcoholism, dia betic neuritis shows no subjective or clinical response to massive doses of parenteral thiamine, the pain, pares thesias, diarrhea, and mental depression persist despite its use Codeine and aspirin offer little or no respite from pain, morphine sulfate and pantopon are not prescribed usually because of the danger of addiction when their use would have to be extended over such a long period, barbiturates are not prescribed because the insomnia is

›y pain, and barbiturates are not specific for

pplication of moist heat tends to alleviate the re often than does medication However, because ·mittent numbness may prevent the patient from relatively intense heat, this treatment is pre- ˏuardedly The moist heat is applied with turkish om which the water has been well wrung The uld be protected with a lubricant before the towel d on it In younger patients who do not have d circulation, moist heat in the form of a tub ·nore satisfactory Recovery from diabetic neuritis akes place eventually, and the nurse should stress t in her conference with the patient, at the same he should stress that complete recovery rarely in less than a year

pness and cold rather than cold alone increase n For this reason, the patient should realize that e vacations are inadvisable unless heated housing ·nodations are available during the evening and vhen dampness is most prevalent During inclem- ather which may bring rain or snow, sleeping windows should not be opened, and blankets be used in place of sheets

ough vitamin therapy by diet, oral, or parenteral stration offers no apparent relief, this form of y is prescribed rather than omitted Multi-vitamin complex capsules are prescribed for oral use, and ne chloride is usually given intramuscularly The , nurse may be called upon to inject thiamine e as well as crude liver extract Normally, the cts as a storage depot for vitamin B ... refore, iver extract would ... min B vent that the d ... nable

the amount contained in his diet If gastric analysis reveals achlorhydria, substitutional hydrochloric acid is also prescribed The diabetic diet permits an adequate intake of thiamine since foods like whole grain cereal, peas, beans, pork, liver, and milk are such significant sources

The diarrhea frequently disappears within a matter of days following the introduction of therapy with crude liver However, the persistence of nocturnal pain and seriously interrupted sleep may discourage the patient as to the eventual curability of his neuritis

NEPHRITIS

Vascular disease, in one or more of the several manifestations, is found not only in middle-aged and elderly diabetics, but in young adult diabetics who have survived their disease for twenty years or more Intercapillary glomerulosclerosis is one of the manifestations of this vascular degeneration The nephritis is characterized by albuminuria, hypertension, edema, and severe retinopathies

TREATMENT

When the condition is recognized early in its course, treatment directed at conservation of the kidney tissue, and sparing of the kidney function may retard the progress of the disease Generally speaking, this treatment consists of teaching the patient to avoid physical fatigue.

If the nonprotein nitrogen level of the blood is increased, the diet protein is usually reduced to a conservative figure of 70 to 80 grams because protein metabolism, more than that of other foods, involves kidney

function This is evidenced by a characteristic rise of the nonprotein nitrogen level in the blood during renal failure

The patient is instructed to omit alcohol entirely from his diet If edema is present, he is advised to add no salt to his food at the table, salt-containing butter and bread are allowed, but foods preserved in salt, like ham or bacon, are usually forbidden Edema occurs when the kidney function is impaired so that salt is not adequately excreted The edema may be localized to the feet and ankles, to the soft tissues surrounding the eyes, or generalized Enteric coated preparations of ammonium chloride are helpful in the prevention of edema, but the continued use of this drug may induce acidosis with characteristic symptoms of nausea and vomiting For this reason, the physician may prescribe ammonium chloride for five consecutive days during each week, to be followed by two days of omission which constitute a rest period

If the patient develops massive edema despite salt restriction and ammonium chloride administration, mercurial diuretics like mercupurin are sometimes prescribed if renal damage is not yet too extensive Mercupurin contains theophyllin as well as a mercurial, it lessens or prevents the reabsorption of water by the kidney tubules, and would be ineffective if the kidney tissue were too diseased to produce urine In glomerular nephritis, mercupurin merely accelerates the glomerular infiltration rate by mobilizing the interstitial fluids Mercupurin is given by intravenous or intramuscular injection, the latter method is used more frequently when the patient is at home, for the drug can then be administered at routine intervals by the visiting nurse

Chronic nephritis is a denegerative disease of long duration, therefore, the visiting nurse will see some patients in the terminal and subterminal stages During the subterminal stage, retinitis is diffuse and vision is markedly reduced so that the patient may retain only enough to differentiate between dark and light This loss of vision together with intermittent nausea, vomiting, and headaches, which are seen in terminal nephritis, causes the patient much physical and mental distress Most nephritic patients seem to realize their eventual prognosis, but their feeling of insecurity is enhanced if the family, doctor, or nurse appears too solicitous, or if former carefully prescribed therapy is no longer carried out The nurse should instruct the family concerning the guidance factor of patients who are chronically ill For example, it would be easy for a sympathetic relative to put the patient's slippers on for him, but the patient's morale would be better if the slippers were left in a convenient site so that he could then assist himself In her visits to the home, the nurse should make a point of mentioning matters of current interest even when she thinks the patient is too ill to be interested The fact that she would mention such things will help to make the patient feel that he may not be so ill as he had thought

A radio is invaluable when loss of vision makes reading impossible The nurse herself may think disparagingly of the so-called "soap operas" which are heard during the daytime broadcasts, but to the confined person they present outside contacts involving problems which are different from his own The nurse would do well to familiarize herself with some of these radio programs so that she may establish rapport with her patient

When anuria or uremia develops the nephritic patient is usually hospitalized

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he is not able always to store enough glycogen in his liver to take care of his varying physical activities For this reason, his blood sugar may fall to unusually low levels three or four hours after his last meal unless small carbohydrate lunches are given between meals Despite the excessive lowering of blood sugar before meals, the diabetic child's blood sugar may rise to excessive heights immediately following meals Such great deviations in blood sugar levels within a twenty-four hour period occur rarely in adult diabetics

The diabetic child, even during his prediabetic period, is frequently characterized by precosity of physical and mental development His parents will usually recall that he walked and talked sooner than his brothers and sisters did Dr White's experience reveals that at onset of the disease, the mental age of diabetic children averages six months above the chronological age, she found the mental age of her diabetic childhood cases, after onset, to be above normal even when physical and physiological age fell below accepted standards of normalcy

TREATMENT

The treatment of diabetes in childhood, as in adulthood, consists of insulin, diet, and education When the patient is a child, his parents receive the greater percentage of education because, although the child learns quickly, he does not have the wisdom required to apply the facts over a long period of time

INSULIN

All diabetic children require insulin, and therapy with insulin should be started on the day of diagnosis When treating diabetes in childhood, the use of insulin is unquestioned because developmental factors must be given

DIET

The diet of the diabetic child is an individualized one, depending largely upon the age of the patient, and therefore requiring changes with the passage of time Dr White's empiric rule for determining the caloric requirements of diabetic children is simple to use and specific for the requirements of childhood The rule allows 1000 calories for the first year, and an additional 100 calories for each added year of age Ten per cent of the total number thus obtained gives the figure for the number of grams of carbohydrate, the fat prescription is approximately half that of the carbohydrate prescription, the protein is 5 to 10 grams less than that of the fat To illustrate, in planning a diet for a diabetic child of eleven years, the application of Dr White's rule would be

Allowance for first year	1000 calories	
Allowance of 100 calories for each additional year (10 × 100)	1000 calories	
Total number allowed	2000 calories	
Carbohydrate allowance (10% of total figure for calories)	200 grams × 4 equals 800	
Fat allowance (½ of that of carbohydrate)	100 grams × 9 equals 900	
Protein allowance (5–10% less than that of fat)	90–96 grams × 4 equals 360	
	Total	2060 calories

DIET FOR CHILD AGED ELEVEN YEARS

Carbohydrate	202 grams
Protein	88 grams
Fat	94 grams

Breakfast	GRAMS	*Dinner*	GRAMS
Egg, 1 whole		Meat	60
Bacon	15	5% Vegetable	150
Oatmeal, cooked	120	10% Vegetable	75
Butter	10	Butter	20
Cream, 20%	60	Milk	120
Milk	120	Orange	150
Orange	100	Potato	60
Bread	30	Bread	30

Supper	GRAMS
Meat	75
5% Vegetable	150
10% Vegetable	75
Butter	15
Milk	120
Orange	150
Potato	60
Bread	30

10 30 A M 2 Uneeda biscuits
3 30 P M 2 Uneeda biscuits
Bedtime 2 Uneeda biscuits and milk 120 grams

In girls the closure of the epiphyses of bone occurs at menarche Thus, the caloric prescription is rarely increased to more than 2200 calories after the age of thirteen years unless menarche has been delayed or development retarded If the calories are increased after epiphyseal closure, adolescent obesity frequently occurs in diabetic girls Calories for boys are increased throughout adolescence to a maximum of 2800

The carbohydrate of the diet is most frequently divided into three major and three minor meals The minor meals, to prevent insulin reactions, consist of 5 to 15 grams of carbohydrate taken at midmorning, midafternoon, and at bedtime

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DEVELOPMENT

Although the majority of diabetic children grow and develop at a normal rate, 10 per cent of them, particularly those with onset under five years of age, fail to achieve normal growth and development Although authorities differ in their opinions concerning the etiology of diabetic pseudodwarfism, the general consensus is that this stunting is rarely caused by nutritional factors, but rather that it is an endocrine disorder resulting from fatigue of the anterior pituitary, congenital anomaly, hypogonadism, or a combination of two or more of these factors Diabetic pseudodwarfism has not responded to high protein therapy alone, but growth has been achieved when the growth hormone of the anterior pituitary has been given together with a diet which is high in protein and calories More recently, gonadal therapy consisting of androgen for boys and estrogen for girls has produced the most satisfactory results as measured in terms of normal growth and development

INSTRUCTION OF THE PARENTS

Instruction of the parents of diabetic children cannot be clearly outlined since personality, economic position, and educational factors vary from family to family The instruction concerning recognition, treatment, and prevention of insulin reactions and acidosis may be written in the notebook, but most of the real problems are best approached by conferences at which are discussed those factors which will enable the parents to anticipate, recognize, understand, and help solve the physical and psychological problems of their diabetic child so that normal parent-child relationship is maintained

INSULIN INJECTION

After the parents have been instructed concerning the theory and practice of insulin administration, they should

then apply their knowledge by giving each other a dose of insulin Frequently one or both parents become squeamish when the nurse suggests this arrangement, but they are usually cooperative after she reminds them that they could not expect their child to accept with docility that which they, as adults, cannot accept Such realizations, however, do not make the situation less of an emotional ordeal for the parents Frequently, the person who is receiving the injection from a novice may complain of faintness, for this reason, he should always be seated during the procedure, since his nervousness is further increased when the novice administrator fumbles awkwardly as he attempts to penetrate the skin with a hypodermic needle

After both parents have given and received a hypodermic injection, thus realizing that the process is a relatively painless one, they are better able to apply themselves to all future instruction The parents must be warned to suppress their emotional reactions when they give insulin to their child because any suggestion of squeamishness on their part, by action or insinuation, will make the child feel that he is undesirable or repulsive The nurse should instruct the parents to alternate in giving the insulin, the mother giving it for one week and the father giving it the next This program will keep both parents in practice, and thus insure safety for the child in the event that one parent is ill or for some reason unable to be at home If only one parent administers insulin, the relationship of the other parent to his child will not be normal, for the child may interpret the situation as meaning that one parent loves him more or less than the other

Many textbooks stress the need for teaching the diabetic child how to take his own insulin Such a plan merits grave consideration For once the child learns how

to inject his own insulin, the parents may give him the full responsibility The danger of this situation may not be apparent until the child has had an episode of coma which occurred because he missed a dose of insulin one morning The child omits insulin for many reasons He may innocently forget to take his insulin, he may omit it as a scientific experiment, he may not think of it until he is on his way to school, and returning home to take it would mean a mark against punctuality or retention after school To the mature adult, such events would leave no room for selection, but the child has a different sense of proportion Under ordinary circumstances, then, the child should not be given the responsibility of managing his own insulin program until he is at least fourteen years of age

DIET

Diet therapy offers many more problems than does the administration of insulin During the first year of his disease, the child usually cooperates remarkably, he thrives on the praise of his elders and even experiences a feeling of superiority at his ability to refuse candy and other sweet foods which are offered him This period is usually of short duration, however, for such behavior is not typical of childhood Those foods which are denied the diabetic child should not be kept in the house If other members of the family feel they must have such food items, it seems unreasonable to expect that the diabetic child can go without them All children enjoy novelty in shape and color of food preparations, and the diabetic is not an exception Therefore, when a weighed diet is used, he should be able to have his bread allowance in the form of muffins or waffles, potato as potato chips, popcorn in place of crackers, and other suitable varia-

tions Sponge cake or angel cake should be worked into the diet as special treats The appearance of frosting on a birthday cake intrigues and delights the child more than the actual flavor A birthday cake looks festive to the diabetic child if the icing is prepared from cream cheese which has been colored with fruit juice, and if the cake is decorated with the appropriate number of lighted candles Just as the normal child has food treats reserved for special occasions, so, too, should the diabetic child have them The nurse, in discussing diet with the parents, should learn about these special family events which frequently take the form of "weenie" roasts and baked bean suppers, the diet should be planned so that the diabetic child will still be able to participate in them Since food like baked beans, sandwiches, and waffles is high in carbohydrate, the meals which include them will be so compact that the child would be both hungry and disappointed unless large servings of food with little food value, such as crunchy 5 per cent vegetables, are also available for him

Box Lunches for School School lunches call for special consideration They are preferable to cafeteria lunches because the latter do not favor diabetic diet patterns The diabetic child usually likes all foods, the larger the diet in bulk, the happier he is This consideration is important because a menu which is correct in content of carbohydrate, protein, and fat may be too compact to suit the child's appetite For this reason, school lunches often present a problem because each slice of bread contains 18 grams of carbohydrate The child's carbohydrate allowance is rarely large enough to include two sandwiches when ordinary sliced bread is used, for four slices of bread would represent 72 grams of carbohydrate In order to know how much carbohydrate, pro-

tein, and fat should be used for the box lunch, one must first analyze the regular noonday diet The noon meal of an eleven year old child would be about as follows

	GRAMS	GRAMS OF CARBOHYDRATE	GRAMS OF PROTEIN	GRAMS OF FAT
Meat	60	0	16	10
5% Vegetable	150	5	3	0
10% Vegetable	75	5	1	0
Butter	20	0	0	16
Milk	120	6	4	4
Orange	150	15	0	0
Potato	60	12	2	0
Bread	30	18	3	0
TOTAL GRAMS		61	29	30

With 3 gram deviaion allowed from these totals, as explained in Chapter VI, the box lunch would contain

Carbohydrate	58–64 grams
Protein	27–33 grams
Fat	27–33 grams

The mother should learn how to do the arithmetic of diet as outlined in Chapter VI, but the nurse ought to plan several lunches with her at first by assigning prob lems to be worked out at home

The first consideration for a sandwich lunch is the bread content Most children seem to want two sandwiches in their lunch box If unsliced bread is purchased, and the bread sliced thin, four slices may be made to weigh 60 grams This amount of bread contains 36 of the possible total of 61 grams allowed in the diet which was analyzed earlier in the chapter If the noon allowance is less than 60 grams, four thin slices of bread with crusts removed will weigh 50 grams, thus using only 30 grams of the total carbohydrate allowed To slice bread thin, the nurse may have to demonstrate that a back

and-forth motion with the knife is essential, the knife should not be forced downward since this motion would crush and tear the slice

Younger children sometimes prefer to bring a hot beverage in a thermos bottle Clear soup or cocoa may be used Two level teaspoons of dry cocoa contain 2 grams of carbohydrate, and one each of protein and fat, milk and water may be added to obtain the desired amount, and saccharin and vanilla used for flavoring If the child buys milk at school, the milk allowance must be increased to 240 grams (8 ounces) by giving less of other foods Milk is most commonly sold in half pint bottles To expect the child to consume only half the contents of the bottle would be too much An 8 ounce bottle of milk contains 12 grams of carbohydrate, and added to the carbohydrate contained in 60 grams of bread, 48 of the total number of grams allowed has now been used A portion of fruit would add about 15 more grams of carbohydrate making a total of 63 grams Thus, the general outline of a box lunch diet is formed Sample box lunch menus based on the diet analysis offered earlier in the chapter are as follows

1	GRAMS	GRAMS OF CARB	PROTEIN	FAT
Butter	10	0	0	8
Bread, 4 slices	60	36	6	0
Meat for 1 sandwich	30	0	8	5
Deviled egg (1) for 1 sandwich		0	6	6
Mayonnaise	5	0	0	4
Dill pickle, 1			negligible	
Plums, 2	80	10	0	0
Milk	240	12	8	8
		—	—	—
		58	28	31

DIET BREAKING

The parents should be warned that diet breaking may occur at any time after the first year of restriction The adult who makes the mistake of thinking that a child gradually grows accustomed to a restricted diet does not understand children They are characterized by a pronounced sense of curiosity, without which they would not learn The diabetic child who is told that he cannot have certain foods like candy, wonders what would happen to him if he ate it One day he does eat the candy, and he feels no different, the routine urinalysis, however, reveals his indiscretion Unless great care is taken, this sort of incident may be the breaking point in cordial parent-child relationship The parents must understand that when they ask the child if he has broken his diet, they are encouraging him to lie

Too often, the child is asked if he has eaten some forbidden food, when he admits that he has, as he may at the beginning, an emotional scene frequently follows The mother may cry in his presence, not as an intended part of his punishment, but because she worries for his life and health Everything must be done to prevent these scenes of highly colored emotion because parents represent security to the child When he sees his mother crying, he is terrified, if he himself is the cause of her crying, he becomes confused and anxious Sometimes the father also becomes upset at seeing his wife cry, and he increases the tenseness of the situation by reprimanding the child These situations, not meant to be cruel, make the punishment out of proportion to what the child has done The parents must understand that diet breaking is not a moral issue, that it does not represent dishonesty, and therefore is not deserving of punishment Should the mother cry before her child, it must be explained to

her that such crying may be motivated by frustration as well as anxiety, for she may have spent many hours planning menu and budget allowances to offer the correct diet to the child who seemingly has not appreciated this effort The nurse will see the wisdom of telling the parents that diabetic children with normal intelligence will inevitably break diet at times, then the parents will not be shocked or surprised when the time comes They should also understand that one bad test does not mean that the child's life is in danger

There is no common solution to the problem of diet breaking, but there are several considerations concerning it which the parents ought to realize In addition to not asking the child if he has broken diet, they should discourage tale-telling by the other children in the family or neighborhood, as the acceptance of such information makes the child feel that he is constantly "spied" upon If someone catches him in the act of pocketing a forbidden item of food, and scolds him for it, this situation, too, will encourage lying, for the diabetic child will immediately retort that he was taking it for someone else Since the futility of proving what the child's original intentions were is obvious, the accuser may find himself in a difficult position as the child emphasizes his innocence by delivering the food item to the person whom he named

When the child first beaks diet, only to find that no infirmity resulted, he is not quite so convinced that he ought to be living on a diet Showing sugar in his urine does not bother him personally, it merely upsets his parents His next step, that of diluting the urine with water, is obvious and logical To him, such a procedure offers a happy solution for he now eats the food he wishes, and his tests do not upset his parents Again, such seem-

child's conception of time differs from that of the adults, and two days of careful dieting may have seemed like an endless period to him An understanding physician will know how to manage this type of situation, for he is frequently called upon to offer guidance and to accept responsibilities concerning the social and economic life *of the diabetic child* The physician not only acts as a buffer for those parents who are too emotionally distraught by the child's physical findings to consider his psychological reactions, but he further protects the personality of the child by establishing good rapport with him, based on recognition of those accomplishments which are not circumscribed by his disease The recognition and praise offered the child in this way help him to accept his diabetes as a challenge

Most children do not object to urinalysis three or four times a day until after diet breaking has started It is the parents who sometimes complain that the testing takes too much time The nurse should make a particular point of explaining that when the daily number of tests is reduced, the child will be tempted to break diet more often If the mother decides that it is not necessary to test before the evening meal, the child logically will select this period to break diet Unless the tests are done *throughout the day, it will be impossible to determine* whether or not supplementary insulin is needed For example, if the child shows sugar in the noon test occasionally, there is no way to determine whether the glycosuria was the result of candy or cookies at morning recess, or an unpreventable factor However, with specific instructions from the child's physician, the mother will appreciate the fact that a small dose of rapid acting crystalline insulin will help to improve the situation If the glycosuria is not treated, the child will lose an appre-

ciable number of calories as sugar in his urine Since one should not question the child as to whether or not he has broken diet, such a routine saves nagging, scolding, and loss of rapport between parents and child

THE DIABETIC CHILD IN RELATION TO HIS FAMILY AND COMMUNITY

The diabetic child needs the moral support of his brothers and sisters as well as that of his parents This desired support cannot be obtained from brothers and sisters if the diabetic child receives unnecessary considerations at their expense If the other children are assigned to a share of household chores of one nature or another, the diabetic child should have assignments, too If the family budget is not large enough to buy bicycles for each of the other children in the family, the diabetic child should not have one In misdirected kindness, the parents may make the mistake of granting special favors to their diabetic child, explaining to his brothers and sisters that this is because he has to "have the needle" every day These decisions lack wisdom and maturity, for they do not help the child to face his situation squarely

At school, the child should be encouraged to participate in extra-curricular activities Most of them, physical and otherwise, are compatible with good control of diabetes although minor adjustment may have to be made Social participations are particularly desirable during adolescence when the young diabetic will be popular with his classmates not because he has diabetes, but because he is a good dancer, a member of the baseball or football team, or an active participant in the social and political program of the school Parents are usually happy to hear that such a normal life is possible

for their child, but their apprehension sometimes causes them to forget their original hopes and desires for him For instance, since the younger child in the grade school tends to come home directly, the mother actually sees him eat his midafternoon carbohydrate, therefore, she does not worry for fear that he will have an insulin reaction However, when he reaches high school, he will not be able to return home directly at the close of school unless he sacrifices normal and desirable social functions such as football games or dramatic practice periods At this time, the diet should be rechecked so that carbohydrate may be taken even in the form of "cokes" if this makes it possible for the adolescent diabetic to establish himself with his contemporaries All his attempts at independence should be encouraged and anticipated Otherwise, the supervision imposed by his parents, which may be out of proportion to his actual age, will foster the development of undesirable personality components, which delay or prevent maturity

The patient who develops his disease in childhood usually excels in scholastic work, but he may need help with social adjustments in a large school Classmates are sometimes reluctant to invite him to parties because he "can't eat anything," or the young diabetic himself may refuse invitations for the same reason, or his mother may be the disturbing influence if she insists that he carry his own refreshments To say the least, such considerations are absurd for they are so easily removed, and yet they are responsible for a great degree of maladjustment during the first year or two at high school, years which are important in social establishment

INSULIN REACTIONS AT SCHOOL

Occasionally the child, or even the adolescent, has no recollection of what immediately preceded his loss of

consciousness Therefore, psychic trauma does not constitute the problem of insulin reactions for the young child who attends primary school The teacher who has him in her class for the entire school day is the person most concerned Even though the child may never have had a real reaction in her class, she worries about him constantly unless the parents or the school nurse assure her that reactions are unlikely to occur if the child has had his lunches at recess periods Most teachers prefer to keep a box of crackers in their own possession so that they can be sure the child receives them at the right time Otherwise, he may forget to bring the crackers from home, or he may eat them on the way to school, or nibble at them during school hours so that he does not have the carbohydrate when he actually needs it Everything possible should be done to prevent reactions in these young children, for should the child have a severe reaction with convulsions, the school may refuse to retain him Such an outcome may prove tragic for the child who may then have to attend a special school for handicapped children He would also have to follow a program of physical education adapted to the needs of handicapped children This program would not be suitable for a diabetic

The adolescent of high school age may develop a severe insulin reaction because it embarrasses him to eat crackers between classes His feelings are understand able, so a less conspicuous mode for carrying and eating carbohydrate should be found A candy life-saver contains about 2 grams of carbohydrate, therefore, half a roll would contain about 10 grams of carbohydrate The prescription of candy on a diabetic program may be startling on first consideration, but this procedure is a satisfactory one in all ways because the candies are of a specific size, and they may be taken inconspicuously

BEHAVIOR PROBLEMS

By an overwhelming percentage, the minor behavior problems presented by youthful diabetics are caused by a lack of parental understanding Parents complain commonly because the children lie to them All children lie during early childhood because their imagination is vivid, and because they do not discriminate between fact and fancy Were it not for his sense of imagination, the child would not be fascinated by *fairy tales* or by *stories* of animals which talk He does not interpret such situations as unreal, and he does not consider the author or the narrator as a person who lies Children lie also because of fear, fear of environmental factors, or fear of punishment Fear and dread of punishment may cause adults to lie To wit are the criminal courts throughout the world Considering these factors, the diabetic child finds many occasions to lie in self defense In addition, his sense of imagination becomes developed in an unusual way, through necessity, to provide him with assistance in breaking diet unobtrusively When the extra apple disappears, he will tell his mother it was eaten by another member of the family When the extra apple disappears a second time, he must think of a different answer, so he says he gave it to a friend The next time, he will say there must have been a mistake for he distinctly remembers there was not an extra apple left over On and on goes the tale because the parents do not seem to realize that the diabetic child is the only person who always knows the answer Later, they may find the incriminating apple cores in the child's room, and the whole story of evasion and subterfuge will come forth After the first such incident, wise parents will realize that their child actually "out-smarted" them, and that his long series of lies was the result of their own lack of understanding

Many less wise parents, however, will expose the child mercilessly, not because they mean to be cruel or unjust, but because they worry about his health or because they are ashamed to have their child lie In her conferences with the parents, the nurse must bring out the fact that their concern for the child's physical health should not overshadow their concern for his mental health, that the lying of a diabetic child concerning his dietary indiscretions is the expected reaction of a normal child who dreads humiliation and punishment Therefore, whether or not the child lies depends upon how the parents react to his dietary indiscretions The average parent has usually attempted to give up candy or cigarettes for as short a period as the six weeks of Lent, so he should have no trouble appreciating what his diabetic child will do when he has been on a diabetic diet for months, even years The nurse should make every effort to correlate the difficult and unsuccessful experiences of the parents with the child's position This procedure is suggested, not to arouse emotional sympathy for the child, but to give the parents an intelligent understanding of the situation, to make it seem more human and less strange to them

Unless the parents are advised to the contrary, they may give up all their outside interests to devote their leisure to the planning and care of their diabetic child The fallacy of such a program should be explained to the parents Otherwise, the child will be supervised so closely that he will be unable to develop sufficient confidence to make decisions, and he will be denied the privacy of thought and action which a maturing personality requires The parents who confine themselves in this manner rarely escape a feeling of martyrdom which they unintentionally but constantly project into the

child's life even after he becomes an adult, they use this feeling of martyrdom to impose their wishes on the child When he breaks diet occasionally, they accuse him of ingratitude and thoughtlessness These accusations are not deliberate, but the natural outcome on the part of parents who do not have a life of their own, which includes participation in hobbies, church and social activities, and the general life of the community in which they live Such an inbred family unit may easily prevent the normal weaning of the child from complete dependence on his parents

Occasionally, diabetic children do present true behavior problems which thwart all attempts at understanding or psychotherapy Dr White believes that these children should have electroencephalographic studies In her experience, the electroencephalograms of diabetic children with bizarre and resistant behavior problems reveal abnormal patterns Since the incidence of epilepsy is high in diabetic children, 3½ times greater than the expected incidence, she believes that proper timely treatment and correctly prescribed sedation will lessen the incidence of epilepsy

CAMPS FOR DIABETIC CHILDREN

Camps for diabetic children offer many advantages Until the child attends camp, he may never have seen a diabetic contemporary The old adage concerning "strength in numbers" seems to relieve the oddity of his situation

A camp which is well organized offers the diabetic child not only a vacation of entertainment and fun, but an annual diabetic checkup which is preferable to hospitalization since it is based on normal physical activity Parents also need a respite from the responsibility in-

volved in caring for a diabetic child who, for obvious reasons, cannot be sent to relatives or friends for a vacation The sending of diabetic children to camp should be one of the principal functions of a diabetic fund since it helps to round out the physical and psychological needs of the youthful diabetic and his family

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XI

DIABETES AND PREGNANCY

PROBLEM

During the pre-insulin era, before 1921, a pregnant diabetic woman was a medical rarity whose life was in danger Coincidental with the discovery of insulin was an *increase* in the *fertility* rate and a decrease in the maternal death rate According to Dr White, the discovery of insulin, however, only emphasized the discouraging fact that *good diabetic care was not sufficient to* solve the problem of excessive fetal wastage in diabetic mothers For surveys, which included the entire forty weeks of pregnancy rather than just the last trimester, showed an infant survival rate of only 50 per cent The introduction of protamine insulin increased the incidence of pregnancy in diabetic women, but protamine did not alter the baffling pattern of consequence, for every other diabetic woman continued to lose her infant

HORMONAL IMBALANCE

The 50 per cent fetal wastage was caused by early spontaneous abortion, premature delivery of a macerated fetus, or delivery of a large infant who died soon after birth Within recent years, research has shown that these obstetrical accidents which destroyed the fetus are associated with a hormonal imbalance on the part of the diabetic mother who does not metabolize the sex hormones, estrogen and progestin During the first seventy to ninety days of gestation, these two hormones are

secreted by the ovaries, estrogen is the proliferating factor and progestin the luteinizing factor Ovarian failure during this early phase of pregnancy would result in a spontaneous abortion At the eightieth to ninetieth day of gestation, the production of estrogen and progestin is taken over by the placenta According to Dr White, if failure of production occurs during the placental phase, the pregnant diabetic woman usually develops, after the thirtieth week, a fulminating type of toxemia which is ushered in by a sudden elevation of the blood pressure, and followed sometimes in a matter of hours, by the delivery of a dead fetus, or of a gigantic but physically inadequate infant which rarely survives

Dr White, whose diabetic pregnancy series is the largest reported in the literature, summarizes her experience by stating three results of pregnancy in diabetic women First, there is the group of diabetic women in whom the sex hormones were metabolized normally, and in which there was an infant survival rate of 96 per cent Second, there is the group of diabetic women whose hormonal imbalance was recognized but not treated with replacement therapy, and in which the infant survival rate was 50 per cent In the third group, patients in whom the imbalance was recognized and treated with substitution therapy, the infant survival rate was 90 per cent Young women with onset of diabetes in childhood frequently have arteriosclerosis and other manifestations of premature aging, if calcification of the pelvic vessels is marked, hormonal therapy may be ineffective

INDICATIONS OF HORMONAL IMBALANCE

Clinically, there are several ways of determining which diabetic women will require replacement therapy

physical ability to bear children from the gynecologic aspect, but also in terms of the presence or absence of vascular-renal disease, so that they will be prepared emotionally as well as financially for the problem of pregnancy and diabetes The hormonal therapy is of great economic importance since it usually costs more than $300 for one pregnancy even when the hormones are sold at cost to the patient The average couple would have difficulty financing such a pregnancy without careful planning, including the consideration of hospitalization insurance The prospective parents are better able to accept the sacrifices involved in such costly therapy when they realize that several hospitalizations without a living baby are far more costly than one which results in a living child However, when the patient is a long-duration diabetic, she and her husband must realize that although hormonal therapy may offer them their only chance of having a living baby, there is always a possible chance of *failure* *In conferring with the individual* woman, the nurse should not permit herself to be too optimistic concerning the 90 per cent survival rate in the treated cases Although the chances for infant survival are overwhelmingly favorable when the hormonal imbalance has been corrected, there is still the appreciable segment consisting of a 10 per cent mortality in the infants of mothers who have received treatment The prospective mothers should be somewhat conditioned for this outcome by being advised not to buy a layette

INJECTION OF HORMONES

The hormones must be given intramuscularly because they lose approximately 90 per cent of their efficiency when they are taken orally The ideal site for the injection is the upper and outer quadrant of the *gluteus maximus*

The patient's husband is taught how to administer the therapy, and the visiting nurse may be asked to instruct him concerning the technique of injection A syringe which holds 10 cc is most satisfactory, although a smaller one may be used since not more than 5 cc is given in one injection One should use a 22 gauge needle, 1½ inches long A longer needle would be too flexible, and a smaller gauged needle would not be satisfactory because the hormonal solution is oily and viscid The injection is less painful for the recipient, and less difficult for the peron who does the injecting, if the viscid contents of the ampules are heated by placing them in a container of hot water just before they are used Both preparations come in glass ampules containing 1 cc Ampules of stilbestrol contain 5 milligrams of the drug, but progestin is prepared in ampules containing either 5 or 10 milligrams As the cost of the hormone is appreciably reduced when the 10-milligram ampule is used, the clinic usually orders this strength to dispense to patients

If the total combined dose does not exceed 5 cc, the two preparations may be given as one injection, after the twenty-eighth week, the dose would be divided between two injections, for the average dose is 20 milligrams of both hormones Twenty milligrams of stilbestrol would mean 4 cc, and 20 milligrams of progestin would mean 2 cc, or a total of 6 cc When the amount of progestin required is 15 milligrams, and the ampules contain 10 milligrams, the patients are usually instructed to take 10 milligrams on one day and 20 the next

CARE OF THE DIABETIC IN PREGNANCY

DIET

Dr White believes that the calories should be based on the actual weight of the pregnant diabetic woman,

in order that the calories may be kept within the desired range For this reason, it is usually necessary to use skim milk rather than whole milk, and cottage cheese rather than the other types of cheese which contain high percentages of fat

Because of the high incidence of pretoxemia in diabetic pregnancies, edema is a common finding Therefore, sodium, as table salt or bicarbonate, is omitted at or before the twentieth week except for a minimal amount found in such foods as bread, butter, and cereal Foods such as ham, bacon, and saltines are avoided Frequently, even when sodium is omitted and protein kept at a maximum, it is necessary for the physician to prescribe ammonium chloride to alleviate the edema

INSULIN REQUIREMENT DURING PREGNANCY

The renal threshold becomes lower during pregnancy, which means that a large amount of sugar, or potential glycogen, is lost in the urine even when the blood sugar is at desirable levels For this reason, urinalysis *no longer serves as a reliable factor in determining* insulin requirements, and more dependence is placed on blood sugar determinations Even when the blood sugar is maintained at satisfactory levels, the pregnant diabetic woman may slip insidiously into a state of acidosis or coma *merely because the lowered renal threshold causes* a continuous loss of needed carbohydrate To help overcome this condition and thus enable the woman to maintain glycogen stores, small doses of crystallin insulin are prescribed before each meal, these are taken in addition to the basic protamine If the pre breakfast insulin dose were to be increased to that amount which keeps the urine free from sugar according to the routine of a nonpregnant diabetic, the patient would be in a more or less constant state of hypoglycemia

Whether or not pregnancy actually affects the diabetic status is a debatable question, since results seem to vary from patient to patient, and reports vary from clinic to clinic Usually, on careful analysis, it is the total number of injections which is increased rather than the total number of units of insulin Many times, the amount of protamine insulin required is markedly reduced When the diabetic woman becomes pregnant, she also becomes more attentive to all phases of diabetic management in her endeavor to have a normal child In addition, the anticipation of responsibilities associated with her coming child produces a more mature emotional attitude toward her diabetes and a more satisfying reason for following treatment Thus, pregnancy of itself may or may not lessen the severity of diabetes, but it usually provides the motive for careful observance of the diabetic routine

DELIVERY

Most authorities agree that cesarean section is the preferred method of delivery when the gravid woman is a diabetic, for although the figure for maternal mortality is low, spontaneous delivery offers many problems The average primipara is in labor for eighteen hours, and the multipara for twelve hours During this time, although the body's need for glycogen is constant and marked, the woman in labor may be unable to eat her food Her restlessness, whether from pain or sedation, makes intravenous therapy difficult The nondiabetic woman is well prepared to meet this situation because she has a normal supply of glycogen in her liver But a combination of the two factors, inadequate supply and greater demand, would make the diabetic's insulin requirements unpredictable in relationship to her need, and would thereby expose her to insulin reaction and diabetic coma Uterine

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XII

THE DIABETIC IN THE COMMUNITY

According to statistical evidence, most diabetics develop their disease at middle age The onset of diabetes at this time of life should not influence markedly the position of an individual in his family, business, or community Most persons, by middle age, have achieved their relative positions in society because their specific and general personality components have been integrated, the pattern of their personal lives has been established, and their means of livelihood determined The average middle-aged person, whether he earns his living in trade, labor, industry, business, or profession usually has a position of more responsibility and prestige than he did in his youth Newly diagnosed diabetics in this age group understandingly make the best adjustment to their disease for when the diabetic condition is controlled, physical impairment is not present, and therefore orientation to a new occupation is unnecessary and undesirable If the individual has attained a responsible position before the onset of his disease, the presence of the same traits which enable him to achieve success in normal living will enable him to adapt successfully to his diabetes

On the other hand, persons who have always been maladjusted, and characterized by emotional immaturity and instability may experience constant difficulty in accepting the limitations of a chronic disease When

these persons, who have always been unable to cope with the common difficulties of life, develop diabetes, they are the "chronic offenders" seen on every diabetic service For them, the simple omission of insulin eliminates the need of facing reality and accepting personal responsibility The sheltered life of the hospital then offers a buffer to their feelings of inadequacy Individuals with these abnormal personality traits who develop diabetes may be incapable of rehabilitation for a lack of essential energy, spirit, and determination anteceded the development of their diabetes Since most personnel departments are supervised by laymen, not physicians, these abnormal traits in a given diabetic may be ascribed to his diabetes rather than to his innate personality deficiency Unfortunately, the experience of the personnel service with one diabetic characterized by marked emotional instability may cause the next job applicant with diabetes to be rejected For example, should a diabetic arrive at his place of employment without having had breakfast, despite instructions and warnings directed against this practice, an insulin reaction might follow During its development, the diabetic might undergo physical and mental changes which might jeopardize his own life as well as those of his fellow workers One such careless incident might give an employer the erroneous impression that all diabetics are liabilities

There are seven states which allow an employee to sign waivers to the effect that the employee himself is responsible for injuries received on the job, but such waivers are unsatisfactory for the diabetic for he might experience an on the job injury which was associated specifically with his work, not with his diabetes, but he would not then be compensated For reasons such as this, the working capacity of diabetics is better known

WORKING CAPACITY OF DIABETICS

The Well-Treated Diabetic is a Productive Worker

ABILITY TO WORK

WORKING TIME LOST FOR ILLNESS *

DOCTORS MUST HELP DIABETICS REMAIN AT WORK

To Protect Working Future of All Diabetics
To Avoid Prejudice of Employment of Diabetics
To Assure Normal Living for Diabetics

REMEMBER *Diabetics Must Be Better than Average To Make Good*

Fig 18

to their physicians than to their employers for the pa tient's obvious solution to the problem of economic independence is to conceal his disease For this reason, one hears less frequently of the conscientious diabetic than one does of the irresponsible diabetic who is remem bered for his bizarre behavior

DIABETICS WITH ONSET IN YOUTH

Unlike the diabetic with onset of his disease following the establishment of his life pattern, young diabetics sometimes must put forth a struggle to be given the opportunity to demonstrate their ability as capable and reliable workers Most industrial and civil service appointments would exclude diabetics, and many large business firms will not accept them knowingly as em ployees Therefore, diabetics who develop their disease in childhood or in youth, before the establishment of economic independence, tend to prepare themselves for creative and unique positions where individual talents and personal interest are essential, and where, in the absence of marked rivalry, prejudice of employers is of less consequence For this reason, the social and economic future of the young diabetic seems assured

Dr H E Eisle reports that the juvenile diabetics who have survived their disease for twenty years or more are engaged in occupations as extensive and diversified in nature as those of a nondiabetic group In his study, he reports on a series of 71 juvenile diabetics who have survived their disease for twenty years or longer, the list of occupations by which these persons earn their living includes merchants, secretaries, laborers, clerks, house keepers, laboratory technicians, an artist, a salesman, a comptometer operator, an accountant, a student, a journalist, a comparison shopper, an electrical engineer,

an advertisement agent, a reporter, and a merchant marine radio operator

Dr Eisle states that the educational achievement of the patients who make up this group is the most striking feature of the study College was attended by 42 per cent (31 persons) of the group, 4 of them had gained academic honors These figures are considered remarkable, because in 1934 only 7 per cent of Americans who were twenty-one years of age and over had attended college Dr Eisle's report further evaluates these figures by classifying the patients' backgrounds according to their parents' financial, familial, and environmental circumstances Thus, there were 10 members in the distinctly wealthy class, 80 per cent of whom attended college, there were 28 members in the professional and moderate income class, 53 per cent of whom attended college, there were 13 members in the low income group, 30 per cent of whom attended college, and there were 22 members in the under privileged class of whom 18 per cent attended college As Dr Eisle has emphasized in his survey, these data, remarkable as they are, should be the most un favorable to reach publication, for the children in his report lived in the preinsulin era at the onset of their diabetes

DIABETES WITH ONSET IN THE AGED

When the diabetic condition is recognized in elderly patients, there may be many more handicaps of physical nature to overcome The earlier appearance and more extensive presence of arteriosclerosis in elderly diabetics has long been recognized This premature aging brings with it several disheartening complications such as retin opathies which may lead to partial loss of vision, and peripheral vascular disease which may lead to gangrene

and thigh amputation These complications are seen more commonly in diabetics at sixty-five years and over than in nondiabetics in a similar age group Loss of vision in elderly diabetics hastens their aging because it makes them dependent on others for many things including insulin administration, urinalysis, care of the feet, and other personal needs Unlike younger persons who become blinded, they frequently do not possess the mental or physical ability to learn braille, trades, or occupations An appreciable number of these blinded persons have generalized vascular disease which is severe enough to necessitate thigh amputation Since loss of vision and loss of limb are both results of the same degenerative aging process, its victims are no longer in the full vigor of life, and therefore cannot always be rehabilitated despite good medical care and supervision Undoubtedly, many persons whose diabetes is diagnosed in late life have actually had the disease many years before diagnosis, and their complications have developed as the result of untreated and unrecognized diabetes The person who develops his disease in middle life, and who learns how to control it, will escape many of the ravages of the disease

CONCLUSION

The position of the average diabetic in the community should not change because of the onset of his disease as an employee, he should prove better than average for his diabetic education makes him realize that he must do a better than average job to overcome established prejudice of employers However, the diabetic must understand that he must keep his disease controlled to achieve and maintain this maximum degree of good health Dr Joslin's citation from William James is aptly

quoted when one is referring to the diabetic's position

"We are spinning our own fates, good or evil, and never to be undone Every smallest stroke of virtue or of vice leaves its never so little scar The drunken Rip Van Winkle, in Jefferson's play, excuses himself for every fresh dereliction by saying, 'I won't count this time!' Well! he may not count it, and a kind Heaven may not count it, but it is being counted none the less Down among his nerve cells and fibers the molecules are counting it, registering and storing it to be used against him when the next temptation comes Nothing we ever do is, in strict scientific literalness, wiped out "*

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